THE

Practical Teacher

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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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School Surgery.

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IX.

THE MOUTH AND THROAT.

THERE are some affections of the mouth which are sometimes very troublesome, and cause much discomfort to children, and in consequence to teachers, such as *Aphthous Ulcers, or Thrush, Cankers, Gumboils, Teething, Toothache, Relaxed Throat,* producing hoarseness, *Aphonia* or loss of voice, *Cough, Hooping Cough, Croup.* These form a convenient section of complaints which may be considered together, and naturally follow quinsy.

Aphthæ are small round white ulcers, which look like particles of cream or curd lying upon, or as if inserted in, the mucous membrane. They are sometimes called *Thrush,* and old women tell us that they are fatal signs when they come on at the end of acute or exhausting diseases. These patches are of considerable interest to the microscopist; they consist of epithelial scales mixed with the isolated cells of a fungus, and with long filaments, which are rarely jointed. The scales are more or less opaque; intermingled with them are the multiplying bodies of vibrios, and bacteria. They are evidences of a defective vitality in the individual, which allows of the development of fungi in places where the ordinary healthy secretions usually have power to prevent their growth. Their presence indicates the necessity for the removal of decaying *débris* from the mouth and alimentary canal, and for disinfectants. The mouth may be washed frequently with a solution of chlorinated soda or a weak solution of Condy's fluid, and the places touched with a strong solution of borax in glycerine. Sometimes small ulcers form in the membrane, which is excessively painful when irritated by liquids or any food. These ulcers have raised edges, with bright red surroundings. They frequently form inside the lips and on the tip of the tongue, and should be gently touched with a solution of nitrate of silver (three grains to one dram of distilled water). If this is done two or three times on successive days, the pain will be at once removed, and the places will rapidly heal.

Cankers, so-called, are owing to want of cleanliness, the presence of carious teeth, to disordered stomach in consequence of eating improper food, or continuing to feed either on that which is unwholesome or on a diet which is too exclusively animal. I have thought that the use of milk or meat which is the product of animals suffering from some feverish complaint has promoted the formation of aphthæ, but this point has not yet been conclusively proved.

Gumboils frequently arise in connection with an aphthous condition, but there is always a decayed tooth which has some decomposing matter in its substance. The discharge from the inflamed part must be promoted by washing the mouth with warm water, and by holding the water in the mouth for a few minutes at a time. A soft fig, made quite hot in the oven, then cut in half, and the soft side applied over the boil, so as to avoid absolute pressure on the tender part, and kept in position as long as possible, will be the most comfortable way to apply a poultice. If the pain continues to be very acute the surgeon's lancet may be the best remedy, and after the inflammation has subsided the carious or necrosed tooth should be removed, if it continues to be tender to the touch. If the tongue is foul and the breath offensive it will be right to administer a simple aperient, such as a dose of Gregory's powder, or some fluid magnesia, or even an emetic, if the stomach is loaded with undigested food.

Teething and Toothache.—Gumboils frequently accompany toothache. The acuteness of the pain of this agonising disorder is often relieved as soon as swelling takes place. When this is the case it indicates peri-dental inflammation, that is, an inflammation in the membrane covering the fang of the tooth. It is generally connected with some constitutional disorder, as a cold, or other disturbing cause. When there is acute pain on touching the tooth, warm fomentation in the mouth, and protection from outer cold, is the best treatment. The sufferer will find breathing through the nose (rather than the mouth) to be the best way to draw in air, for a draught of cold air impinging on the exposed nerve is a source of pain. Irritating applications, such as creosote or spirits of any kind, which are often used to allay pain, are of no service whatever. They only add to the mischief; although they may relieve pain for the moment, it is sure to return again more severely than before. Swelling of any kind near to a tooth

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should be treated tenderly with fomentations, and the use of liquid food until the boil has softened and discharged. If the tooth is hollow or carious, the pain sometimes may be relieved by picking out of the hollow tooth some small particle of decomposing food or some portion of hard matter which presses upon the exposed and inflamed nerve. Even by protecting the latter from the air by inserting a flake of cotton-wadding, soaked in some disinfectant and inserted very carefully, so as to avoid all pressure upon the nerve, we may save the little patient some suffering. If there is extending decay in the tooth it may be arrested by active astringents or stimulating applications, such as creosote, camphor, or essential oils; but all these kinds of applications are of doubtful utility in the end. They relieve pain for the moment, but it is sure to come again. Soda will arrest fermentation for a time, and so may ease suffering when it arises from this cause. All these actions indicate decay in the teeth, and require the care of the dentist to arrest its extension.

Loose teeth should always be removed, as they only cause irritation in the gums, and interfere with the formation of healthy saliva. They prevent the child from masticating his food properly, and lead him to swallow it uncomminuted, and thus throw a duty upon the stomach which it is not always able to perform. There is consequent indigestion, and with it an inability to do the mental task which the rules of the school require to be done. The child is then blamed improperly and unjustly. He knows that the fault is not altogether his own, and so a loose fang may be the first cause of mutiny and disorder among the scholars. These latter conditions, when they arise, are generally founded upon some concealed injustice in school-life as well as in the weightier arrangements of state government, and concerning which the actual governor is too often ignorant.

There is a condition connected with teething which is not often thought of. We are generally inclined to think that teething ceases when swaddling clothes are put aside, and that the second set give no trouble on this head. This is not so; the second set of teeth often set up a considerable amount of nerve irritation when they come through the gums, especially if they have not followed the usual order, and have not at once taken the place of the milk-teeth which have preceded them in the gums. This is not quite so absolute in the case of those teeth which have a predecessor proper; but the canines or eye-teeth often produce headache, and cause an interference with eye-sight when they are about to pierce through the gums, producing a congestion in the conjunctival membrane. This condition is not ordinarily considered, but the frequency with which headache, and a tendency to cold in the eyes, as it is called, is associated with a canine tooth about to pierce the gums, satisfies me with the correctness of the association, and the necessity which exists in such cases to attend to the digestion and to the nervous system, rather than to the discharge from the eyes and nose, which is only an accompanying discomfort. The nerve disorder which attends upon cutting the wisdom-teeth is even more decided than that which accompanies canine dentition. The gums get swollen and hot, the secretion of saliva is lessened, the tenderness interferes with mastication, and food is swallowed in lumps, indigestion arises and still further complicates the case. If the patient be exposed to draught, or kept in a heated room until the skin acts freely and is then chilled by cold air, sore throat, or at least a relaxed throat, arises, cough sets in, perhaps bronchitis or some other feverish condition; the minor evil, which was the first cause, is lost sight of, and the major trouble treated. The gum irritation subsides when the disease which it has set up is gone, and solid food begins again to be taken, the gum is bitten upon and again crushed. There is a recurrence of the whole story, but the real offender is not thought of. I have seen convulsions of a serious character arise in cases of this kind, which have recurred, and in the end would have set up distinct epilepsy, but for the discovery that a wisdom-tooth was at the root of the evil. The offending gum has been lanced, and the convulsive tendency has ceased at once. Wisdom-teeth are not to be neglected when they are being cut. They are the last to come, and generally they are the first to go, and we have a series of throat affections connected with their entrance into the mouth as well as with their removal therefrom.

It is necessary for the schoolmaster to be aware of the fact that dyspepsia, headache, relaxed throat, cough, croup, and even convulsions may be simply dependent upon a decayed or cutting tooth. Fœtid breath very often indicates a number of decaying teeth in the mouth. If food is left for a few hours in a hollow tooth it is sure to become more or less putrid, and serious disorders or continued bad health may be produced by a small particle of decaying animal matter in a hollow tooth.

Large schools should always have dental officers attached to them, who, by a periodical inspection of the teeth of the children will be able to avert decay, remove loose fangs before they produce general disorder, and this may be the means of stopping the progress of much dental mischief.

It is not sufficiently known that the second set of teeth appear in the mouth before the first set are shed. A child six years old will generally have twenty-four teeth whilst there are only twenty temporary. The extra four are the first permanent or six-year old molars. They are supposed to belong to the first set, and when they decay, which is often the case, it is thought to be of no consequence. These teeth often have slight decay in the enamel, which may be arrested if it is seen soon enough. They are the largest teeth in the mouth, and should never be removed unless absolutely necessary in consequence of complete destruction. They should be stopped if the decay is discovered early enough, and if stopping cannot be effected, a free application of disinfectants before and after food will assist to limit the ravages of the caries, and be the means of saving the tooth until the jawbone is properly developed. Parents should bear in mind, and dentists also, that the too early removal of a permanent tooth interferes with the regularity of the development of the jawbone, and sooner or later is followed by other changes.

The deposit of so-called tartar upon the teeth is always a matter which requires attention. The deposit is various in its constituents: it consists of organic as well as inorganic matter; there is *débris* of food as well as *débris* of animal life; its presence depends upon a constitutional as well as a local cause. If removed it often rapidly forms again. The cause must be corrected by an attention to the condition of the digestive organs, and a rapid

removal of the collected tartar, especially when, as is generally the case, it is accompanied by fœtid breath. The varieties are numerous, but the majority can be easily remedied by the proper use of disinfectants. If there is any inflammation or sponginess of the gums, or tendency to hæmorrhage, each must be treated independently of the formation of the tartar; and it is probable that if the one condition is removed, the other will cease. Hæmorrhage, or bleeding from the gums, is sometimes an evidence of improper feeding; fruit and vegetables have been withheld, and a scorbutic tendency set up, which shows itself in loosening teeth and bleeding gums. The signs of mischief may be observed by the master, when the parents have not seen them, or have mistaken their significance. The state is one which can only be remedied by an alteration of diet, by a restoration of those kinds of food which nature requires. The aggregation of people in dense numbers, such as takes place in large cities, is a great impediment to the supply of the fresh fruit and vegetables; and yet such food is necessary for healthy digestion and a proper development of the second set of teeth.

When a teacher observes the state mentioned, it would not be out of place for him to send a line to the parent, and suggest more fruit and vegetables, and less animal food or pastry for the child. The removal of a tooth is occasionally followed by considerable bleeding; when there is constitutional tendency, it will be good for the child to take lime-juice, as well as well-cooked green vegetables, so as to remove the tendency to hæmorrhage, and to obviate further evil.

I am sometimes asked if tooth-powder is a necessary thing for a child to use, and how soon toothbrushes become necessary articles for use in the bed-room. It is wise to clean the teeth with some antiseptic powder, such as finely-levigated chalk or charcoal, whenever the teeth are decayed, but ordinarily with undecayed teeth too much friction with the brush is to be avoided. It would be best to wash the mouth out, and to gently clean the teeth at bedtime, so as to remove decaying food from between the teeth and out of the hollows before it has had time to decompose, rather than leaving it all night in the mouth, and so causing offensive breath. This is the principal use which renders a toothbrush an advantage, which does not arise from the friction which is so often advised. You will not keep the teeth white by brushing them severely, but you may assist in doing so by removing decaying food from between them, and keeping the digestive organs in good order.

(To be continued.)

Eminent Practical Teachers.

DAVID STOW,

Founder of the Training System of Education.

BY JOHN R. LANGLER, B.A., F.R.G.S.,

Of the Westminster Training College, Ex-President of the National Union of Elementary Teachers.

II.

'ON the 8th May, 1845—probably the most trying day in his public career—Mr. Stow stood for the last time in the splendid Normal College which he had founded and fully equipped. It was a beautiful summer morning, but the assembled pupils had evidently little heart for their accustomed play. The wheels of amusement moved heavily, and, except with the youngest, there seemed to be a prevailing consciousness of something wrong, something that ought not to be. Gloom was falling unnecessarily on sunny hearts. Two years had passed since many a manly tone had faltered as pastors, true to their cherished principles, closed their last services in the church they loved; and bitter tears had bedewed many a mother's cheek as she left the manse endeared by the tenderest associations of sorrow and joy, while distress had quivered on young lips as children left behind them their gardens and their play-fields. These changes had become inevitable, but the formal discipline might have been averted, which extended to the common school the gloom of the church and the manse. It engraved on young minds recollections of these inexplicable changes; but with many of the more advanced pupils it deepened the consciousness that Christian men could make heaviest and most enduring sacrifices for what they conscientiously held to be sacred principles.

'As Mr. Stow stood that morning among his students, masters, and brother directors, a slightly deeper flush than usual was all that indicated his disappointment. He accepted the new conditions of labour and resolutely strung himself to new exertion. Other hearts there are burdened with their own sorrows—one is taking a last look at the young currant-bush which he was permitted to plant on the border of the playground, and another has left a tear glistening on her favourite flower.

'But the signal for preparation to leave gathers into the large hall all stragglers. Thrilling is that song of praise, and deeply impressive that voice of prayer, as the goodness of the Lord is acknowledged and His guidance sought.

'The assembly moves from the building, directors, teachers, fifty students, 700 pupils, and at last the quiet old Janitor with his wife, locking the door and joining the procession, left a seminary, lately instinct with life, tenantless and silent.

The whole fabric is completely deserted; the joy of youthful voices thrills no listener, and the sunbeams, all the day pouring into empty halls, beating on the floor, and at last creeping slowly on the walls into twilight, only made the desolation greater. The procession—headed by Mr. Stow and Mr. Nathaniel Stevenson, a beloved companion and fellow-labourer in every good cause—having threaded its course through a multitude lining the streets, passes into the extemporised canvas-covered school. When the new seminary had been opened with praise and prayer, appropriate and hopeful addresses were delivered, but not a complaint was uttered, nor was there any special allusion to the circumstances in which they were placed. "Every person will admit," said Mr. Stow, "that the buildings of the institution are not the institution itself; even this temporary building, embodying as it does all the trainers, students, and children, will exhibit the system as it existed ten years previous to the erection of the edifice which we have now left; it was then the Glasgow Normal Seminary, and such it must continue to be!"'

'The tents were the abode of the Normal Seminary until August, 1845, when the new building was formally opened, and the work continued still under Mr.

Stow's personal superintendence, and under more favourable outward circumstances. The Free Church had been led to accept the responsibility of many schools whose masters and mistresses had been dismissed, and in Edinburgh as well as in Glasgow a Normal College had to be formed for the preparation of teachers for their work. By the exertions of the Rev. Dr. James Buchanan, the Glasgow Seminary was erected at a cost of £10,000, of which sum £3,000 was a grant from Government. Students in the Scotch Colleges are not resident as in England. The new 'Seminary,' therefore, consisted only of four large halls for the model practising schools, with class-rooms, students' rooms, library, and museum, etc., with, of course, spacious playgrounds, in connection with the four schools.

Since the retirement, in 1840, of the Rev. Robert Cunningham, from the Rectorship, financial difficulties had prevented the appointment of a successor. On the entrance upon the new premises, however, Mr. Robert Hislop, who had for several years been the head master of the senior school, was chosen as the Rector. 'His exact scholarship, his thoughtful appreciation of Bible training, his deep sympathy, as a teacher, with Mr. Stow's views, and the command which his Christian character gave him over the students, invested his appointment with public value.'

Every one who reads this sketch will be acquainted with the 'Minutes of Privy Council of 1846,' but comparatively few can remember the surprise with which they were received, and the earnestness with which they were discussed in all parts of the country. As 'the result of one of the most benevolent, unfettered, and exact investigations of modern times made into the details of public instruction through individual enterprise,' they especially challenged the attention of all practical educationists. Mr. Stow's ardent Christian philanthropy was ready to accept any means of usefulness which these Minutes seemed to promise, and he sought to secure for Scotland such modifications as were more adapted to the long-established arrangements of that country. In this effort he was not sufficiently supported, and the 'Minutes' were therefore made applicable to England and Scotland alike. Monitors were to be superseded by pupil-teachers; Queen's Scholarships were offered; salaries were to be augmented by a direct grant from the Government, and according to a scale of nine degrees of merit; retiring allowances were promised; and in other details the Minutes framed by Sir James Kay Shuttleworth encouraged many, who, like Mr. Stow, were struggling hard against ignorance and vice, to hope for the most favourable results to the country.

Monitors were little used in Scotland, though in the schools founded by both Lancaster and Bell they were an important part of the 'system.' In his four 'departments' Mr. Stow dispensed with the aid of monitors in intellectual training. Children of nearly the same age were 'trained' together, and in large numbers. He demanded the best teachers for *all* grades; and he considered fifty to sixty or, at the outside, eighty children quite enough for one teacher. From want of funds this number has often been exceeded, and many 'trainers' have managed schools without assistance, even when the children have not been of 'nearly the same age.' But Mr. Stow always urged that in order to effective teaching, the numbers should be small, and he resisted the employment of inexperienced 'apprentices.' On every ground he demanded even for the youngest classes highly qualified teachers and carefully-trained assistants.

The effect of the operation of the 'Minutes' on the Glasgow Normal Seminary was distressing to Mr. Stow in the conversion of that institution into a teaching college. Many a University student had entered the Seminary for the one object of learning the theory and methods of education; but by the introduction of Queen's Scholars, the former class of students began to decline in numbers as they were excluded from the Government grants, and very shortly the principal part of the time and energy of the staff and students was devoted to the necessary preparation for the inevitable Christmas examination. Mr. Stow urged that separate colleges should be adapted to the completion of such education as the Government might demand from Queen's Scholars, and that all students who were duly qualified should subsequently pass to the Training College, and there learn the best methods of applying their knowledge for the purposes of instruction. 'If the arrangement of uniting instruction and training be continued in the same institution,' he added, 'then THREE YEARS, at the least, ought to be the minimum course, viz., two years in the preparatory college, and one year afterwards exclusively confined to the practical or normal as a separate department.'

It will be thus seen that Mr. Stow attached the highest importance to the training of the *teachers*, who, during their professional career, necessarily have the 'making or the marring' of so many minds, and the formation to a large extent of the moral character. He sought to secure men and women of sterling piety, and of considerable mental culture, and to give them a '*practical preparation* for the important work of communication and moral training, which was our original object in establishing the first Normal Seminary in this country, and without which all the theoretical knowledge that the students may acquire will not enable them to communicate it in a natural and efficient manner to the pupils who may eventually be placed under their charge.' 'Our experience during twenty years up to 1847, when we added a college to the Normal Department, was this, that six months' exclusive practical attention of well-educated young men to the normal, made better trainers and teachers of schools than the present course of two years does, or can do, with the college and normal combined.' Mr. Stow always affirmed that for the development of the child's intellectual faculties it was of far greater importance *how* he was taught, than *what* he was taught. Hence the anxiety manifest in the extracts quoted above for a proper equipment and skill on the part of the trainers. There is accumulating evidence that the opinion of practical educationists is now more in accord with these views of Mr. Stow.

In June, 1851, Mr. Robert Hislop resigned the rectorship of the Normal Seminary to enter upon another sphere of public usefulness, and again, for a period of six months, Mr. Stow had to bear the chief burden of the institution. Mr. Thomas Morrison, M.A., whose scholarship and success as a teacher had attracted the attention of the directors, was appointed rector in February, 1852, and 'Mr. Stow found in him a cheerful, energetic, and highly talented coadjutor.' Dr. Morrison still ably presides over the Free Church College.

For several years the work of the Normal Seminary

Institution was carried on without any changes of importance. The 'Minutes of 1846' and their supplements were confessedly conferring 'immense educational advantages' upon the country. The desire to have education placed on a national basis, however, led to the introduction of measures into Parliament which only 'secured ecclesiastical contests and merited rejection.' Mr. Stow naturally shunned controversy, but in some vigorously written pamphlets and letters he maintained the principles of Bible-training. He never attempted to 'mix religion with the multiplication table,' but he desired liberty to appeal to the Word of God at any hour of the day, and 'whether the classes were at arithmetic, at grammar, or in the play-ground,' to bring that Word to bear on lying, swearing, dishonesty, or any act of meanness that might occur. The particular schemes which he opposed need not now be named. While he required freedom for the teacher, he equally insisted upon the advantage and necessity of confining religious exercises—praise, prayer, and the Bible lesson—to a fixed hour. His one contention was: '*Scriptural* school-training is my only hope for the permanent elevation of the masses.'

The Social Science Congress was held in Glasgow in 1860, and under the presidency of Sir James Kay-Shuttleworth, a resolution was passed to appoint a committee to consider the whole question of education, with a view to instituting a national system. The committee failed, and legislation was attempted without the investigation upon which so much stress had been laid.

Mr. Stow made his last public effort at this Congress, by reading a paper on 'Moral Training' in the Educational section. The purpose of this devoted philanthropist was to show the advantages that would result from the universal adoption of the system which had been found to be so effective, especially in the more neglected districts of large towns.

The two greatest British educationists of the age, Sir James Kay-Shuttleworth and David Stow, were associated on this occasion. They lived 'for the same great end, the physical, social, and moral welfare of the people.' They both sought to secure that end through the same agency, the common school. They both embodied their conceptions in practical forms, and, notwithstanding unreasoning opposition, 'contributed more than all other men of their time to change the educational aspect of Britain.'

Mr. Stow's personal appearance was not such as to attract special attention. His stature was rather under the average height and 'on 'Change' he would not be specially distinguished from other first-class Glasgow merchants. His frank and open countenance seemed to challenge confidence, whilst shrewd intelligence and habitual caution could be read in his face, which, nevertheless, bore a most cheerful expression, with a genial humour ever manifest around his radiant eye. His emotions were readily interpreted by the easily controlled tones of a pleasant voice, as well as by the responsive play of his features. In the various benevolent enterprises to which he devoted his life, and especially in his Sabbath-evening school, his ready sympathies had been much exercised, and he had acquired a power of voice and gesture which made his manner a helpful expositor of his instruction. In this respect he was an example to all teachers, who often have to attract and sustain the attention of weary children, or 'picture out in words' novel or complex conceptions.

His enthusiasm was contagious, and as his unselfish labours were persistently pursued, the esteem of those who were trained under him merged into a desire to obtain more of his spirit and to imitate his example. Their character could be hardly formed on a better model, for in every respect Mr. Stow was a Christian gentleman. He was fortunate in securing for his Normal Seminary a staff of teachers of similar character and culture, and probably not a single student was ever known to leave the institution but with a feeling of regret at being removed from its ennobling atmosphere. Every student trained by Mr. Stow respected and loved him. The earnestness, the enthusiasm, the self-sacrificing devotedness of his life, won their admiration; while his courtesy and his personal interest in them all invariably gained their affections.

In the year 1850 a few friends resolved to present Mr. Stow with some expression of their regard for him as a Christian friend, and of their estimate of his labours as an educationist; but, their purpose being made known, others wished to join in the testimonial, which thus necessarily assumed a public character. Teachers sent contributions even from distant lands. The presentation took place in 1851, at a meeting presided over by Henry Armstrong, Esq., the Inspector of Wesleyan Schools, and which was attended by many distinguished educationists.

The chairman, in the course of his address, said: 'There are some men whom we are bound to honour, because God has honoured them, and separated them from the mass of their fellows by placing them in prominent positions, as the representatives of some great principle, and the instruments of some great work—men living before their age, labouring not only without sympathy or any just appreciation, but borne down by an amount of toil of which the world at large knows but little, whilst their actions and motives have been misunderstood. He held it as a fixed principle that no man had ever lived for the good of others, and had become a blessing to his species, since the Lord Jesus honoured humanity by clothing Himself with it, but by the denial of himself, taking up his cross and following his Master.'

An appropriate address was read by Mr. Caughie and given to Mr. Stow, and a marble bust resting on a beautifully proportioned column was uncovered and presented. On the pedestal was inscribed:—

DAVID STOW,
AUTHOR
Of 'Moral School Training for Large Towns,'
FOUNDER
Of the Training System of Education
and
Of the Glasgow Normal Seminary,
The First Established in Great Britain.
Presented by the Teachers Trained in the Institution.
1851.

The likeness was admirably rendered by the sculptor, Mr. H. Ritchie, of Edinburgh. A second bust had been provided for the hall of the Normal Seminary.

'The affectionate cordiality with which Mr. Stow was received when rising to reply must have been more welcome to him than the gift itself.' His speech was characteristic not only of his natural modesty and

Christian humility, but also of his unabated faith in the principles of the Training system, based as it was upon the Bible. The Revs. Dr. Buchanan, R. Cunningham (the former rector), Mr. Hislop (the actual rector), and others not directly engaged in educational work, united on this occasion in paying homage to the resolute founder of a system which had already proved itself to be so effective wherever it had been fairly tried. The occasion was one of great interest, and there are some still living to whom it remains a joyful memory.

The 'beautiful character' of Mr. Stow gradually unfolded in the privacy of domestic life does not of necessity come within our purview. But it may be recorded that by his marriage, in 1822, to Miss Marion Freebairn, a 'young lady of decided piety, highly accomplished, and of great personal attraction,' he was for nine years greatly aided in the work to which he had devoted his life. Mrs. Stow died in 1831. His eldest son, William, having distinguished himself at Cambridge, accepted the vicarage of Avebury, Wilts, and died in April, 1852. The next son, John, died in the following December. In 1841, Mr. Stow was united to Miss Elizabeth MacArthur, whose death took place in 1847. A son and a daughter survived their father.

During the last few years of his life, Mr. Stow was shut out from an active share in the work of the Normal College, and resided chiefly at the Bridge of Allan, occasionally visiting Torquay (1861) and other places to recruit his failing strength. But when he had reached the 'threescore years and ten' he could take but little active interest in educational affairs. His protracted illness resulted in continually increasing feebleness, and limited his visitors to a narrow circle. He constantly referred to his early experiences in the Sabbath-school, and, in reply to any who spoke of the great work done by him, in deep humility he insisted that he had been an 'unprofitable servant,' but thankfully acknowledged the results which had been developed from such unpromising beginnings. 'On the 6th of November, 1864, the day broke and the shadows fled. In his seventy-first year he finished his career. Britain lost in him one of her foremost educationists. He yet lives in the heart and memory of those whom he led to consecrate their energies to the cause of Christian education, and who are now filling spheres of public usefulness in various parts of the world.'

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Anecdotal Natural History.

BY REV. J. G. WOOD, M.A., F.L.S.,
Author of 'Homes without Hands,' 'Nature's Teachings,' etc.

AND THEODORE WOOD, M.E.S.,
Joint Author of 'The Field Naturalist's Handbook.

No. XIV.—ELEPHANTIANA—*(continued.)*

STILL beyond a few remonstrances, no great objections were made to Jumbo's removal. Indeed, the generality of the visitors to the Zoological Gardens did not even know the animal's name, nor, indeed, could most of them distinguish one elephant from another. Even on the eve of his departure from England I heard several persons assert that the female Asiatic elephant ("Suffa-Kulli") was Jumbo, while, on the other hand, there were quite as many who pointed out Jumbo as one of the Indian elephants.

One morning, however, there appeared in one of the daily newspapers a vivid and dramatic account of an attempt to take Jumbo out of the Gardens, so as to accustom him to the road.

We were told how he suspected a trap, and bewailed his hard lot; how he knelt to his keeper, caressed him, and in all but human words besought for restoration to the home of his childhood. We learned how the other elephants from within their houses responded to his piteous appeal, and how they all rejoiced together when he returned among them.

As by magic, a Jumbo literature sprang up. The president, secretary, superintendent, and other officers of the Society were inundated with letters, mostly composed of vituperative epithets. Even persons like myself, who have no connection with the Society, but were known to take an interest in animals, received letters from all quarters on the same subject. None of the writers seemed even to conceive the idea that the officers of the Society were likely to understand their own business, and would not part from such an animal without very good reasons for doing so.

Then the Jumbo-worship set in. A Jumbo Rescue Fund was started. Presents of the most fatuous description were showered on the animal. Visiting cards with "farewell" were attached to his box, which was simply covered with farewell messages in pencil.

That basket after basket full of hot-house grapes should be given to him we can understand, though the grapes would have been better employed if given to sick poor who needed them, and who would not have eaten the baskets as well as the grapes.

But it is scarcely possible to conceive how many human beings could have been so ignorantly foolish as to present an elephant with several boxes of cigars, packets of snuff, a leg of mutton, and six dozen oysters.

From their nature these gifts seem to have been presented by donors of the male sex. But feminine presents are even more absurd than the masculine. No one, however imaginative, would have thought that a widow's suit should be sent to Alice, to be worn on Jumbo's departure. Or that numbers of ladies would send their photographs for Jumbo's consolation during his absence from them. Or that measurements of his travelling box should be taken, so that it might be decorated with wreaths of flowers.

Can anything be much more absurd than such conduct as the following? "On Wednesday, we saw a lady weeping copiously in the Gardens. With streaming eyes and a moist handkerchief, she was testifying to the violence of her grief, inveighing against the brutality of allowing Jumbo to *catch cold in his legs!*"

It is impossible not to recall Trinculo's soliloquy on discovering Caliban: "Were I in England now, as once I was, and had this fish painted, not a holiday fool but would give a piece of silver. When they will not give a doit to relieve a lame beggar, they will lay out ten to see a dead Indian."

One case, however, outdoes in absurdity all the previous instances of human folly. Here is an extract from the first column of a daily newspaper, the names being suppressed:—

"On the 27th ult." (*i.e.*, February, 1882) "at ——, the wife of H—— B——,'Esq., of a son and heir (Jumbo)."

Here each sex is equally responsible, as both husband and wife must have concurred in saddling their unfortunate "son and heir" with a name that will afflict him during the whole of his life, and, if he should go to a public school, will be a perpetual torment to him. "Tristram Shandy," of Sterne, or Lord Lytton's "Anachronism," "Pisistratus Caxton," were nothing in comparison of "Jumbo B——."

Then legendary history was foisted upon Jumbo, and among other fables we were told that "he had been on exhibition at the London 'Zoo' for nearly sixty years, and that upon his back Queen Victoria and the royal family and thousands of children have ridden."

Now, all this outburst of Jumbo-worship was the work of a few days, the rest of the animal's life in the Zoological Gardens not exciting the least enthusiasm in the public mind, even among those who had ridden on his back when boys and girls, and had in after years lifted their own children into the familiar howdah.

Yet to all naturalists the years in which he passed from infancy to adult age were full of interest, and to none more so than to myself.

Some twenty-five years ago I stated ("Illustrated Nat. Hist.," i., p. 739) that I believed the African elephant to be quite as well fitted for the service of man, and that the reason why it was not captured and tamed might be found in the inferiority of the negro race when compared to the Aryan. Many of the elephants which were employed in the days of ancient history were undoubtedly of the African species, as were those highly-accomplished animals which are stated to have walked along a set of ropes, carrying a companion in a litter.

That an African elephant should be brought to England was an epoch in Zoology, especially as the animal was very young, and might therefore be expected to live sufficiently long to enable its disposition to be carefully studied. He was then scarcely as large as an ordinary Shetland pony, and, up to the present time, when he is eleven feet in height at the shoulder, and weighs some seven tons, he has proved quite as gentle and docile as any of the Indian animals. His compatriot "Alice" has also proved herself as intelligent and capable of subjection to man as either of the two Indian elephants.

Yet the art of elephant taming has not been practised in Africa for many centuries. The natives can kill them by catching them in pitfalls, or by the "drop-trap," *i.e.*, a device by which a log of wood, armed with a poisoned spike, or a long, double-edged blade, is dropped upon them from a height.

Some tribes, more courageous than the rest, can hunt down the animal, and mob it to death, flinging spears at it until the creature dies from weariness and its multitudinous wounds.

Bravest of all are the Agageers, so well described by Sir S. Baker.

They hunt the elephant in pairs, one being armed with a long, straight sword, the edge of which is kept as keen as that of a razor, and the other being unarmed. When they hunt, both mount the same horse, the armed man being behind.

Picking out an elephant with good tusks, they ride towards him and attract his attention. The man with the sword then slips off and hides himself under any convenient bush which they may pass. His companion then irritates the elephant, until it charges him. The horse, which is always of the swiftest kind, and carefully trained for the purpose, intentionally keeps just so far in front of the elephant that the latter thinks of nothing but catching it.

In course of the chase, the horseman passes close by his comrade's hiding-place, the elephant being too much excited to detect him. As the great beast passes, the hunter steps from his ambush, and with a single blow severs the tendon of the heel, which in the elephant is close to the ground. The animal is instantly rendered powerless, and can be killed without the possibility of resistance.

Even if the tendon be only partially severed, the next step is sure to snap it.

Yet in spite of the ingenuity of inventing such a feat, and the cool daring by which it is accomplished, no Agageer ever dreamed of taking the elephant alive. Nor would the Zulus, bravest of the brave as they may be, and utterly reckless of their own lives, attempt such a feat. They have been known to catch a lion alive, at the command of their king, but the very idea of taking an adult elephant alive would not have entered the head of Chaka himself.

Now, both the Agageers and the Zulus are of a much higher type than the negro, and it is therefore not at all wonderful that the negro cannot tame the elephant when tribes which are far superior to him fail to do so.

In general formation, both species very nearly resemble each other, and if the skull were removed, it would not be easy to decide whether the rest of the skeleton belonged to the African or Asiatic species. The form of the head is, however, very different, especially in the living animal.

In the first place, the enormous comparative size of the ears in the African species renders it so conspicuous that even when the animal is at rest and the ears are pressed closely against the head, there is no possibility of mistaking one species for the other. These ears, however, are best seen from the front, when the elephant is excited. In such a case, they stand out boldly on each side, looking like a pair of huge black wings.

Looking at the two species in profile, it is easy to see that the forehead of the African is convex, while that of the Asiatic is concave Looking at them from the front, the head of the African narrows below the eyes, and then widens again, very much like that of the hippopotamus.

Its form is due to the manner in which the tusks are set in their sockets.

In the Indian species, the sockets run nearly parallel to each other, so that the skull is of tolerably equal width.

Both species have the peculiarity that if, when wounded, they once fall, they never rise again. The lions, tigers, bears, and even the buffaloes, will spring to their feet even when mortally wounded, and often kill their slayer with their last struggles. But the dying elephant "subsides like a great hayrick," to use Mr. Sullivan's words, and expires so gently, that the hunter is often uncertain whether the animal be dead or merely resting.

Ivory workers often find bullets imbedded in the tusks. They have struck the root of the tusk, which is hollow, and filled with pulp, and have been gradually carried towards the tip by the growth of the tusk. In the ivory turners' department of the Crystal Palace, there are some very curious examples of imbedded balls. In one case, the track of the ball is

marked by a tunnel of bone extending across the base of the tusk, the ball itself having passed towards the point.

As is the case with the whale tribe, the brain of the elephant is very small in proportion to the size of the head, and is so deeply sunk in its bony outworks, that the hunter must aim as accurately as if shooting at a sparrow.

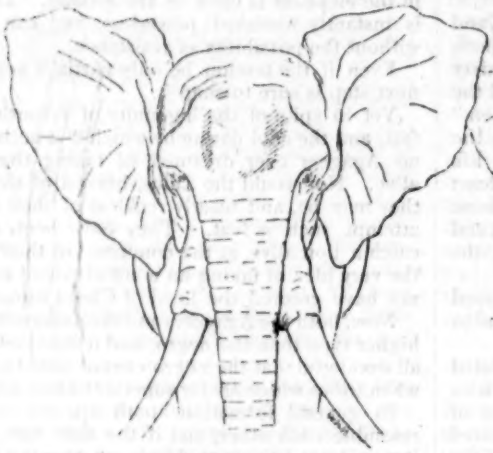
It is quite common to find in the skulls of slain elephants the marks where bullets have passed through the honeycomb-like mass of bone which surrounds the brain, and where the damage has been repaired by Nature. There are several such specimens in the College of Surgeons.

If the African elephant cannot be induced to turn his side towards the hunter, the only hope of the latter is to aim at one of the legs so as to disable it.

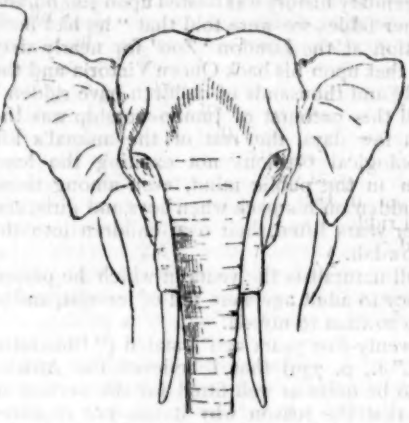
The late Gordon Cumming once owed his life to an accidental shot which broke the elephant's leg and rendered it powerless. As it could not stir, he, knowing very little of anatomy, tried to find its vulnerable points by shots at short distances. After receiving with comparative indifference ball after ball, it sank dead from a shot which took effect between the eye and ear.

He incurred much blame for the heartless cruelty of this proceeding, but in reality he saved pain to hundreds of other elephants, not to mention human lives.

It was far more humane to learn how to kill an elephant instantaneously with a single shot, than to allow the animals to be caught in pitfalls and transfixed by a stake, or to be slowly tortured to death by countless spear wounds.



African Elephant.



Asiatic Elephant.

Also, with the flesh of the elephants he fed whole tribes of starving natives, and so he brought the ivory into the market with the least possible pain to the animals, and the greatest possible good to the various native tribes, which depend largely on the elephant for their subsistence.

Section of Skull of Elephant.

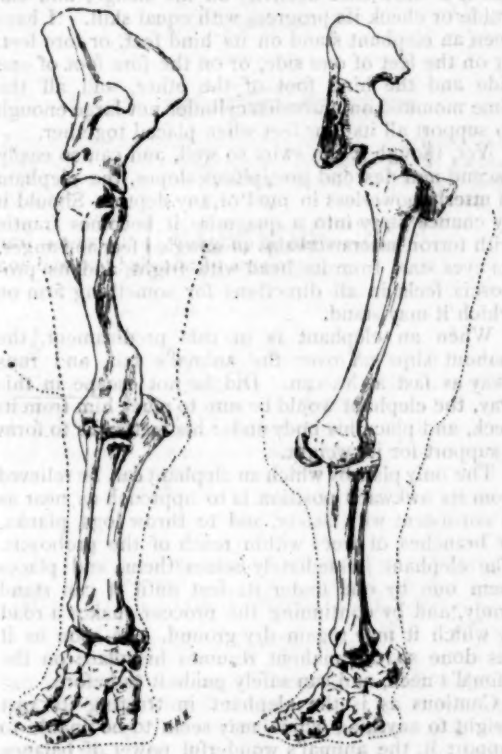
Both species have a similar gait. When they walk they do not, like the horse, move the feet alternately and diagonally, but walk alternately with the feet of each side.

Moreover, instead of bending the leg at the so-called "knee" and "hock," as the horse does, and furthermore bending it again at the pasterns, the elephant scarcely bends its legs at all, but swings them forwards and backwards, planting the heel first on the ground, just as man does. In fact, the

elephant is, in our modern athletic slang, "a fair heel and toe pedestrian."

A glance at the skeleton will show the reason for this gait. In the elephant, the "cannon bones," or "shank bones," *i.e.*, the middle metacarpal bone of the fore foot and the middle metatarsal bone of the hind foot are not lengthened as in the horse, and the entire foot is brought close to the ground, all five toes resting on it.

This peculiar structure of the legs enables the elephant to use them as offensive weapons. It does not kick with its hind legs like the horse, nor strike, boxer fashion, with its fore-feet, like the stag, but it hustles its foe backwards and forwards under its body, kicking it forward with the hind feet, and then



Fore-leg. Hind-leg.

backward with the fore feet. In this way it has been known to destroy a wild boar and a tiger, and in both cases the elephant was a female which was defending her offspring.

It is strange to see how artists ignore this structure, even when they are engaged in scientific work. I have now before my eyes a well-known zoological diagram for schools, in which the elephant has knee, hock, and pasterns just like a horse, and to make matters worse, is standing with the pastern of one hind foot gracefully bent!

I may here mention that the footprint of an elephant designates the size and serves to identify the animal.

It is found by measurement that twice the circumference of the foot is equal to its height at the shoulder. Now, the circumference of "Jumbo's" foot slightly exceeds five feet six inches, so that his height is a little over eleven feet.

The identity of the animal is shown by the lines which cross and recross each other in the sole of the elephant's foot, just as do the lines of the palms of our hands, and which are imprinted on soft ground. When hunters track an elephant, they copy these lines, and so are able to adhere to the "spoor" of the same animal, even when it has been mixed with the footsteps of many others.

These great feet, which can crush a tiger into a jelly, and which have to support a weight which is measured by tons, are as silent in their tread as those of a cat. All elephant hunters know that elephants can glide noiselessly through thick forests, where even the barefooted savage can scarcely tread without betraying his whereabouts.

Even upon the highroads of this country, where the shod hoof of the horse is audible far off, the elephant swings his mighty bulk along without apparent effort, and so silently that "the blind mole may not hear a footfall."

Huge as it may be, no creature is so difficult of detection. Dr. W. Knighton, the Cingalese elephant hunter, tells me that in the forests of Ceylon you may be standing within a couple of yards of a nine or ten feet elephant, and not be able to distinguish the animal from surrounding objects. Its legs are just like tree trunks, and its brown body merges so imperceptibly into the sombre forest shadows, that the eye is incapable of discerning it.

Both species are playful, and are even fond of toys. In one case, a large wooden ball was given to the elephants. But they became so excited with their toy, hurling it about as if it were shot from a cannon, that the keepers were obliged to remove it.

Both species practise a most curious mode of avenging themselves when angered.

In Mr. Baldwin's work on African hunting, it is mentioned that fully half a mile from any water a tolerably large crocodile was found, hanging in the fork of a tree about ten feet from the ground. The natives seemed to be familiar with this strange position for a crocodile, and said that the reptile had been put there by an elephant.

They stated that when the elephants wade into the lake (Nyami) for bathing purposes, the crocodiles are apt to worry them and bite their legs. Sometimes, when an elephant is annoyed beyond all patience, it picks up the crocodile in its trunk, puts it among the branches of a tree, and leaves it there.

The truth of this curious story is corroborated by the behaviour of an Indian elephant, very inappropriately named Pangul, or Fool.

The animal knew perfectly well the weight of the burden which he had to carry, and if he were overloaded, either refused to stir, or shook off his load by wriggling his skin.

One day an officer was trying to overload him, and became so angry at seeing the load repeatedly thrown off, that he flung a tent-peg at the elephant. Pangul took no notice at the time, but a few days afterwards he met his persecutor alone. Pangul immediately picked him up with his trunk, put him among the branches of a large tamarind tree, and left him there to get down as he could.

Gigantic as the elephant may be, it is horribly afraid of any small quadruped. A kitten which happened to stray among some elephants drove them half mad with terror, occasioning as much unreasonable consternation as a cockroach or mouse in a drawing-room full of ladies.

Yet, an elephant has been known to take a fancy to a cat, or rather, the cat took a fancy to the elephant. She had a fixed idea that his back was a sleeping-place expressly designed by nature for her, and on his back she *would* go. At first, the elephant took her off his back and put her out of his cage, but as fast as he put her down in front, she slipped round and climbed up his hind quarters again. So the elephant let her have her own way, and soon became quite attached to the cat.

The reader may remember that I have alluded to the assistant male elephants which play the part of the Philistines to the captive Samson, just as the koomkies take the part of Delilah.

These assistant elephants are as carefully trained to fight as our modern boxers, and, as with man, size and brute strength are of small avail before practised skill. The professional fighting elephant knows beforehand every move in the game,—when to bump his antagonist against a tree and thrash him on the neck with his trunk before he can recover from the shock, when and how to use his tusks, and when to charge with his whole weight against his adversary.

Some of these trained elephants have been sent to Africa for the double purpose of capturing African elephants and of showing the more intelligent tribes how to take elephants alive instead of merely killing them for the sake of the ivory.

The account of their transit is a very interesting one, but too long to be given in full. There was much the same difficulty in embarking them as was found with "Jumbo," but there was much more difficulty in landing them.

Owing to the peculiar shore of Zanzibar, the ship could not approach within two miles of land. At last it was decided to lower one of them, poetically named "Budding Lily," into the water, and induce her to swim ashore.

So she was slung over the side, and let gently into the sea, with the mahout on her neck. Now elephants, when bathing, are rather fond of playing a practical joke on the mahout. They sink themselves beneath the water so as to give the mahout a sound ducking, while they can breathe through the end of the proboscis, which is held out of the water.

"Budding Lily" played this same joke, but when she rose to the surface became alarmed and tried to scramble on board again. The captain of the ship sent a boat, which tried to tow the elephant landwards, but the animal was too strong, and dragged the boat back to the ship's side, up which it vainly attempted to climb.

After more than an hour had been thus wasted the elephant suddenly comprehended the situation, and swam towards shore, accompanied by the boat. Some sand-banks on the way afforded it resting places, and in about four hours after leaving the ship the first Asiatic elephant set foot on African shore.

There was little trouble with the other elephants, for they took courage from the conduct of their companion, and swam ashore after her.

One of the elephants of the Jardin des Plantes, of Paris, used to play an absurd trick with the visitors. She would sink herself until only the tip of the trunk projected from the water, and she was thereby rendered practically invisible. Then she would send a torrent of water over the spectators, who could not imagine where the deluge came from.

That elephants should be such admirable swimmers seems very remarkable, and especially that they should have such propulsive power as to drag back a boat fully manned. The capability of sinking or rising at will in the water is equally remarkable, and is owing to the power of contracting its body so as to render it heavier than an equal bulk of water.

Activity, again, seems no characteristic of the elephant. Its apparently stiff and ungainly legs, which can swing some fourteen or fifteen feet at each step, although well enough adapted to carry the huge body along at a swift pace, appear to be totally inadequate to perform feats of activity.

Yet the elephant can climb rocks where one might think no animal but the goat would venture. It can slide down a steep hill just as a "coaster" slides down a snow-clad declivity on his sledge, and can guide or check its progress with equal skill. I have seen an elephant stand on its hind feet, or fore feet, or on the feet of one side, or on the fore foot of one side and the hind foot of the other, and all the time mounted on a wooden cylinder not large enough to support all its four feet when placed together.

Yet, though it can swim so well, and can so easily ascend and descend precipitous slopes, the elephant is utterly powerless in mud of any depth. Should it by chance stray into a quagmire it becomes frantic with terror, utters screams of mingled fear and anger, its eyes start from its head with fright, and its proboscis feels in all directions for something firm on which it may stand.

When an elephant is in this predicament, the mahout slips off over the animal's tail, and runs away as fast as he can. Did he not escape in this way, the elephant would be sure to pluck him from its neck, and place his body under his feet so as to form a support for its weight.

The only plan by which an elephant can be relieved from its awkward position is to approach as near as is consistent with safety, and to throw logs, planks, or branches of trees within reach of the proboscis. The elephant immediately seizes them, and places them one by one under its feet until it can stand firmly, and by continuing the process, makes a road by which it may regain dry ground. As soon as it has done so, the mahout resumes his place on the animal's neck, and can safely guide it as before.

Cautious as is the elephant in trusting its vast weight to anything which may seem to be unable to support it, the animal's wonderful power of balance enables it to step for almost incredible distances from one foothold to another.

First, it surveys the intervening distance, and carefully takes the measure of it. Then it leans forward, and stretches its proboscis forward so as to test the strength of the next foothold. Guided by the proboscis one fore foot is then pushed forward until it obtainst a hold.

Next follows the hind foot of the same side, and then the fore and hind feet of the opposite side are gradually transferred to their new situation, the ever restless proboscis always acting as pioneer of each step.

No one who has not seen it can realize the marvellous delicacy of the whole proceeding, or the perfection of balance shown by the apparently ungainly animal.

Judging by appearances, the elephant is about the last animal in the world which we should have thought to be swift of progress on land and in the water, a rock-climber, silent of tread as a cat, almost

invisible among trees, and capable of slipping through dense forests without shaking the boughs or producing a sound that would betray its presence. Still less could we expect that it should be able to perform the extraordinary feats of agility which have already been mentioned.

Yet it does all these things, and, most wonderful of all, its vast strength, its powers of intellect, and its other great gifts are made to be subservient to man.

I was never more impressed with the truth of the passage quoted at the beginning of this article, than by watching the mode in which the enormous animal was rendered helpless by man, into whose hand all living creatures are delivered.

(To be continued.)

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Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.—(*dictated*).

409	
63	
780	
5	462
110	290
Ans. 1367	Ans. 172
4070503	925
4	319
162S2012 Ans.	Ans. 606

Steam, Water, Drink, Postman, Penny, Eyes.

STANDARD II.—(*dictated*).

In a school there are 18 long desks and 6 short ones. In each long desk there are 7 girls, in each short desk there are 5 girls. How many girls are there in the school? Ans. 156.

	4095
	510
	29000
39407	69015
16526	39
Ans. 22881	Ans. 102659
	58673
4)23561	39
Ans. 5890—1	Ans. 2288247

STANDARD III.

(1) I sell 25 shillings' worth of eggs at 13 for a shilling and have still 27 left. How many had I at first? Ans. 352.

(2) Divide one hundred and nine thousand and forty-nine by one hundred and sixty-seven. Ans. 652—165

(3) Take four hundred and nine pounds thirteen shillings and tenpence farthing from ten thousand and thirty pounds ten shillings and ninepence. Ans. £9620 16s. 10¾d.

(4) Add together four hundred pounds thirteen shillings and sixpence, ten shillings and one half-penny, nine shillings and elevenpence farthing, fifteen thousand and fifty pounds twelve shillings and six-pence, sixty pounds ten shillings and fourpence, eight thousand nine hundred and sixty-seven pounds seventeen shillings and eightpence three farthings, and four five-pound notes. Ans. £24,500 14s. 0½d.

(5) In a cricket club 17 boys paid 6d. each. They collected also £1 1s. 6d. They paid for wickets 5s. 6d., bats 12s. 6d., and balls 3s. 6d. How much had they left? Ans. 8s. 6d.

STANDARD IV.

(1) What change would a man have out of a £5 note if he bought 17 railway tickets at 2s. 9½d. each? Ans. £2 12s. 6½d.

(2) Divide eighty thousand and four pounds and ninepence three farthings by seventy-nine. Ans. £1012 14s. 2¼d.

(3) How many ounces are there in 1 ton 11 lb.? Ans. 36,016 ozs.

(4) Find the number of square inches in 13 square yds. 3 sq. ft. Ans. 17,280.

(5) Find the total amount of a collection if the box contains 17 half-crowns, 29 florins, 59 shillings, 116 sixpences, 47 fourpenny pieces, 100 threepenny pieces, 1080 pence, and 520 half-pence. Ans. £18 9s. 10d.

STANDARD V.

(1) If a boy cuts 200 corks in 45 minutes, how long will it take him to cut 360 of the same size? Ans. 81 mins.

(2) A man buys 3 lbs. 8 oz. of tea at 1s. 11d. for a lb. and a quarter; how much does he pay? Ans. 5s. 4⅜d.

(3) I buy 250 engravings at 10s. 6d. each, and frame them at a cost of 3s. 11d. each. If I sell each framed picture for a sovereign, find my gain. Ans. £69 15s. 10d.

(4) Find price paid for a field of 3 rd. 35 per. at 100 guineas an acre. Ans. £101 14s. 4½d.

(5) Bill: 25½ lb. of sausage at 7d. per lb.
250 cans Australian mutton at 1s. 11½d.
½ cwt. potted meat at 6d. per lb.
13 doz. tins salmon at 7¾d. per tin.
4 lb. 4 oz. ham at 1s. per lb.
Ans. £31 17s. 5½d.

STANDARD VI.

(1) How many candles, each weighing 1⅞ oz., are contained in 3¾ cwts.? Ans. 5376.

(2) Take 9 thousandths from 1, and divide the remainder by ·0025. Ans. 396·4.

(3) What decimal is 1⅗d. of 3s. 1½d.? Ans. ·042̇6.

(4) A butcher has a sirloin of beef weighing 20¾ lbs. He cuts off 6⅞ lbs., and sells it for £1 1½; what would he sell the remainder for at the same rate? Ans. 9s. 3d.

(5) Ten men work 8½ hours a day for 9 days in making a road. How many men would do it in 9 hours a day, working 5 days? Ans. 17.

Domestic Economy.

STAGE II.

(1) What are the constituents of carbonic acid gas? Show how men and the vegetable kingdom respectively require different kinds of air for their nourishment; and explain how a balance in the atmosphere is thus kept.

(2) What is ventilation? Explain the different methods of ventilating a room, and state which you prefer, and why.

(3) Describe the process of digestion and show how the body is kept in repair by food. What food will especially be required to prevent the bones of a child becoming soft and rickety?

(4) What food contains in itself all the constituents required for nourishment? How much food does Dr. Lankester say that a healthy infant of six months old and a strong man will respectively require in the course of the day?

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(1) To what machine would you liken the body and the food which enters it? Explain particularly how force is produced.

(2) Explain why a room, which is crowded with persons, becomes unhealthy.

(3) Name the different kinds of food.

(4) What is dust? Give some methods for dusting. How would you dust a room so that the dust shall not remain in it?

STAGE III.

(1) Describe breadmaking.

(2) How would you treat a person who was burnt or scalded?

Physical Geography.

STAGE II.

(1) Explain the cause of land and sea breezes.

(2) What do you mean by 'Saturation' and 'Dew Point'? Explain Hoar Frost.

(3) What is an ordinary basin like? How would you describe the map of a basin? Draw and describe the basin of the Tyne.

(4) What is the composition of the air, and in what proportions? Are there any minor constituents?

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(1) How is it that trade-winds do not move exactly from north to south or south to north?

(2) Where does the water in the rivers come from? Why do we talk about water circulation?

(3) Explain why it is that there is more dew on a clear night, and also more dew in an open place than under a tree.

(4) Explain the effect of heat on vapour or air. Also the effect of cold.

'How I Teach Elementary Science.'

BY RICHARD BALCHIN,

Head Master of the Gloucester Road Board School, London.

FOURTH-SCHEDULE SUBJECTS: MECHANICS.

NOT one of the least of the difficulties a teacher of elementary science has to contend with, is to and himself supplied year after year with the same old charts, or so-called 'illustrations of natural philosophy.' Very ancient ideas of science are here illustrated. 'Solidity' is represented by a nail stuck into a piece of wood. 'Liquid displacement' by a block of stone in a vessel of water, without any attempt to show the relation between the size of the block and the quantity of water displaced. Then we have duly pictured all the old nonsense about centrifugal and centripetal forces. Finding these two latter terms on the chart, an inquisitive boy asked what they meant. One of his companions in the class volunteered an explanation; and gave as the 'cause' of the moon's revolution about the earth, the joint action of these two forces. The boy, in point of fact, gave expression to the popular notion, viz., that the moon is kept from flying *away* from the earth by the centripetal force, and kept from being drawn *to* the earth by the centrifugal force. The boy, like a good many others, had been taught to think this a full and sufficient explanation. He believed he quite understood *why* the moon revolved about the earth. Now, in reality, there are no such forces as are here spoken of. They are mere creatures of the imagination. Man in the early stages of intellectual growth solves all problems by referring to a God. I was once busy in the chalk tunnel at Riddlesdown, digging out a beautiful shell, the 'lima spinosa.' A very affable man who had been watching me said, 'Ah, you geologists think you know all about how those shells came there.' 'Yes,' said I, 'we think we *do* know something about it.' 'But you don't,' said he. 'Indeed,' I rejoined, 'do *you*?' 'Yes,' he replied, 'God put them there at the creation, and you'll never get any further than that.'

In like manner I observe in the present day a growing tendency to refer all phenomena to the operation of some one or other 'invisible force.' What people mean when they talk of 'centripetal force,' in the case of the moon's revolution, is simply its tendency to fall *to* the earth, *i.e.*, its gravity. And by 'centrifugal force' they mean the tendency of the moon to continue its motion in a straight line, *i.e.*, its inertia. If the gravity were greater than the inertia, the moon would fall *to* the earth; if the inertia were greater than the gravity, the moon would quit the earth altogether. We are, as I have said before, unable to say anything about the causes of gravity or inertia; these are simply names of observed tendencies. We neither understand nor can explain their causes, and those are no whit better off who think they have entirely settled the thing by diving into the depths of their imaginations and bringing up the forces centripetal and centrifugal.

The following is the outline of a lesson on 'Liquid displacement,' a subject to which I devote four lessons. This is the first :—

Smith, do you remember that I found one of the ink-wells too full yesterday—in fact, it was all but running over? Ans.—Yes, sir, but I don't think I filled it like that, some one must have put some more ink in after I left it. (A boy)—It was Adams, sir. Adams! what have you been doing? Ans.—(Adams) I put some peas in. Why? Ans.—Please, sir, this boy, Eve, gave me the peas and told me to do it. Very well, then I shall have something to say to you both after the lesson; but *now* I will ask one or two questions about it. Was the ink-well so full before the peas were put in? Ans.—No (from Smith), it was only half-full. Was there any more ink in after Adams put the peas in than before? (No answer.) Did Adams put any ink in? Ans.—No, sir, there was just the same quantity. Then what made the ink rise to the brim? Ans.—Because the peas were in. But why should *that* make it rise? Ans.—Because the peas took up room. (A boy)—You told us all about that a long time ago. In my exercise book I have written, 'No two things can occupy the same space at the same time.' (Another boy)—That's not quite right. I have 'No two portions of matter can occupy the same space at the same time.' Well, Jones, is not that all the same thing? Ans.—No, sir, because this is not true if the things are not matter. This room may be full of a great many different sounds all at the same time. What of that? Ans.—*One* of those sounds might be quite enough of itself to fill the room. Very good, Jones, then we are talking of matter only. Tell me what the fact that Jones has just read from his book has to do with the ink-well's getting so full? Ans.—The peas took up the space that was filled by the ink, so the ink was pushed away, and if Adams had put in any more peas, the ink would have run over. Very well, now look at these two glasses. This larger one will hold just a pint; it has a little lip or kind of spout at its rim for the water to run out when the jug is over-full. This smaller glass, you see, is square at the top and bottom, and is the same size all the way up. The bottom is exactly one square inch. You notice I have marked a scale of inches up one of the sides: five inches, you see, from the bottom to the top. Now I will pour some water in: there, I have poured in enough to rise one inch in the glass. Tell me how much water is in? Ans.—One inch, a cubic inch, a square inch. What do you mean, Drayson, by a square inch of water? Ans. (Drayson)—I meant a cubic inch? But why not a square inch? Ans. Because that would only just cover the bottom. (Another boy, Howell)—No, it wouldn't. A square inch is only surface: it says in my geometry book that surface is length and breadth only, no thickness, so that's nothing. What's nothing, Howell? Why, sir, if the water didn't have any thickness, there wouldn't be any water at all. (A boy, Drayson)—You can't measure how much water there is by square measure; that is a cubic inch of water in the glass. Just so, my boy, hence you should have thought before you spoke. Now I will pour some more water in: there, it has risen up two inches. How much water is in? Ans.—Two inches. What sort of inches? Ans.—Cubic inches. How much would this glass hold altogether? (A boy)—Please, sir, how many cubic inches would that pint glass hold? Ah! that is a point I did not intend to notice in this lesson. Do you particularly want to know, Smith? Ans.—Yes, sir, because I was thinking that you could easily find out. Indeed! How? Ans. (Smith)—See how many of those small glassfuls the pint will hold. Very well, Smith; as it is so easily done, come out and do it. (Smith fills the pint glass with six of the smaller.) Now stop. Is it full? Ans.—No, not quite. How many cubic inches are in now? Ans.—Thirty. Before you put in any more, Smith, I will place a glass under the lip to catch any that may run over. Now go on. There, when he was just finishing another five, it began to run over. Now pour what has run over into your cubic inch measure, and see how much there is. Ans. (Smith)—About half a cubic inch. Then how many cubic inches are in a pint? Ans.—Thirty-four and a half. Very good; are you satisfied, Smith? Ans.—Yes, sir. Then you may write on the board the fact you have discovered, and go to your place.

Look, boys! I have here two little cubes of lead, each exactly a cubic inch. I have put some thin wire round each block, so that I can hold up the cube by the wire. Brown, come here. The pint glass, you see, is full. Put the empty five-inch glass under the lip. Now take one of the little cubes and let it down gently into the water; look, boys! some water is running over. The little block is now quite immersed. Brown, look at the measure; how much has run over? Ans.—Exactly a cubic inch. Very well; now put the other cube in. How many cubic inches of lead are in the water? Ans.—Two. And how much water has been displaced? Ans.—Two cubic inches. Good. I will now take one of the cubes, and, with this hammer, beat it all out of shape. There, would you call it a cube now? Ans.—No, sir. What shape would you call it? Ans.—It has no shape. What word do you use for that which has no shape? Ans.—Shapeless. Yes, this is a shapeless mass of lead. (A boy, raising his hand)—Please, sir, you just said it wasn't a cube. Well, do you think it *is?* [Ans.—Yes, it's a cubic inch of lead just the same as before; you haven't taken any lead away. (Another boy)—It *is* a cubic inch of lead, but it is not a *cube*. (The previous boy)—How can it be a cubic inch if it's not a cube at all? Ah! stop a minute, boys. What sort of a mass did I just say this was? Ans.—A shapeless mass. Very well, then, it's without shape. Had it shape before I hammered it? Ans.—Yes. What was the name of that shape? Ans.—A cube. Then what is the word cube a name of? Ans.—Shape. When I wanted Brown to measure how much water there was in that glass, what terms did we use? Ans.—Cubic inches. Is the term 'cubic inches' the name of 'shape' or of 'measure'? Ans.—Of measure. Now how much lead is in this shapeless mass? Ans.—A cubic inch. Is it a cube? Ans.—No, sir, it has no shape. Can any boy come out here and prove before the class that this shapeless mass contains just a cubic inch of lead? (Several boys answer)—Yes, sir, I can. Eve, you may come out. (Eve comes out and dips the lead into the liquid, when it displaces a cubic inch.) Adams, what have I here in my hand? (Adams, looking embarrassed)—Some peas, sir. Come here, Adams: take this handful of peas and find how many cubic inches there are. Adams fills the pint glass with water, then puts in the peas, when about four cubic inches of water are displaced.) Ans.—Nearly four cubic inches. Very good. Now you can both go to your places. Can any boy tell me what

act we have really been proving this morning? (Nearly every boy in the class raises his hand)—Yes, sir, I can. Tell me what it is. Ans.—When you put anything in water, the water that runs over is just as big as the thing you put in. (Another boy)—When you put a thing of a certain size in water, the bit of water that runs out is just the same size. (A boy, Howell)—Please, sir, that's rather silly. What's rather silly, Howell? Ans.—Why, to talk about a 'bit' of water; or water being as 'big' as something else. Well, what would *you* say? Ans.—I should say the 'quantity.' (Another boy)—I shouldn't say 'run over;' I should say 'displaced.' Very well; now I will write the fact on the board; but instead of using the words 'bigness,' or 'bit,' or 'size,' or even 'quantity,' I will use the word *bulk;* this, therefore, is what we have proved this morning:—'A body, immersed in water, displaces its own bulk of the liquid.'

(To be continued.)

—o—

Scholarship Examination, 1882.

QUESTIONS WITH ANSWERS.

MALE AND FEMALE CANDIDATES.

Geography and History.

Three hours allowed for this paper.

All candidates must draw a map, and answer question 8. They may answer *four* other questions in each subject.

Geography.

1. Draw a map (showing physical features only) of—(*a*) Ireland, *or* (*b*) North America, *or* (*c*) Hindostan.

2. Explain the terms cardinal points, horizon, meridian, plateau; give the difference in time, and the distance between two places situated on the equator in longitude 40° E. and longitude 40° W. respectively, and state the latitudes of London, Edinburgh, Dublin, and Liverpool.

Cardinal points.—The chief points of the horizon are called cardinal points; and are named North, South, East, and West.

Horizon.—The horizon is the line where the sky and earth seem to meet.

Meridian.—A great circle passing through the poles, and cutting the equator at right angles.

Plateau.—An elevated plain or tableland.

40° East and 40° West represent a distance 80° apart; reckoning $60\frac{1}{8}$ English miles to a degree, this would mean a distance of ($60\frac{1}{8} \times 80$) 4,808 miles.

The earth turns on its axis once in twenty-four hours or ($360° \div 24$) 15° per hour. A difference of 80° represents a difference of time of ($80 \div 15$) five hours twenty minutes.

The latitude of London is 51° 31′ N.; of Edinburgh, 55° 57′ N.; of Dublin, 53° 21′ N.; of Liverpool, 53° 24′ N.

3. Name four counties in England, Scotland, and Ireland respectively, which are rich in minerals; and give a full account of one of the border counties of England or Scotland.

England; Northumberland, Durham, Devon, Cornwall.
Scotland; Lanark, Renfrew, Fife, Ayr.
Ireland; Kilkenny, Cork, Donegal, Galway.

Northumberland is one of the border counties of England, and lies between the Tyne and Derwent on the South, and the Tweed and Cheviot Hills on the North. It is separated on the West from Cumberland by the Pennine Range, and is washed on the East by the North Sea. It covers an area of 2000 square miles, and is seventy miles long from N. to S., and fifty from E. to W. Its surface is diversified; in the N., W., and S.W. it is hilly, sloping gradually to the German Ocean. The soil is fertile, producing corn and other agricultural produce in abundance, and the hills provide excellent pasturage for sheep, a peculiar breed of which is named from the Cheviot Hills. It is watered by the lower course of the Tweed, by the Aln, Coquet, Wansbeck, Blyth, and the Tyne; and several sheets of fresh water receive the name of the Northumberland lakes. Its coast is seventy-five miles long, and is rocky and dangerous, Lindisfarne, or Holy Island, the seat of an ancient monastery and bishopric; Coquet; Farne Islands, the scene of Grace Darling's bravery; and St. Mary's Island being near it. Northumberland has one of the largest coalfields in the world, and its S.E. part is covered with large numbers of colliery villages and towns, Blyth, Morpeth, Bedlington, Cramlington, Dudley, Ashington, Killingworth, and Seghill, being among the number. Its large towns also depend largely upon the export of minerals, and the manufactures dependent upon them for their prosperity. These towns comprise Newcastle-on-Tyne, a port, and noted for its manufactures of steam-engines, cannon, chemicals, iron goods, and glass; North Shields, noted as a port, and for its ship-building and iron-foundries; Hexham, the capital of the agricultural district, and Alnwick, Wooler, Berwick, Blyth and Morpeth. Numerous ruins of castles (Warkworth, Norham, Tynemouth, Dunstanburgh, Bamboro') and several noted battle-fields (Flodden Field, Otterburn, Hexham, and Hedgeley Moor) attest its later historical importance, while the remains of Hadrian's wall and the names of several places show its connection with earlier English history. The accompanying sketch map marks the chief places of interest.

4. Describe a coasting voyage from Southampton by way of Lisbon to Constantinople, taking in cargo at six of the principal ports on the northern shores of the Mediterranean Sea.

Sailing from Southampton Water we pass westwards through the Solent, and rapidly steam into the English Channel, leaving the Needles on our left. Steering now S.W., we soon sight the island of Ushant, off the N.W. coast of France, and, prepared for a rough voyage, make for Cape Finisterre, a bold headland in the N.W. of Spain. Passing by Oporto with its stores of wines, our first calling station is Lisbon. Here we discharge a portion of our cargo of manufactured goods, and as the ports to which we are sailing are pretty well supplied with fruits, receive only as freight some tons of salt and bales of cork. Our way now lies past St. Vincent and Trafalgar, ever memorable in British warfare, through the Straits of Gibraltar, eastwards into the Mediterranean. Skirting the coast of Spain, and passing the ports of Cartagena, Valencia, and Barcelona, we call at Marseilles. Here we discharge some of our coal, and take instead silk goods, wine, and brandy. Leaving Marseilles we call at Genoa, once one of the greatest commercial cities in the world, and still having upwards of 100,000 inhabitants, taking in manufactured silk goods; then at Spezzia for some of its famous marble; then at Leghorn for hats; then pass along the coast of Italy to Civita Vecchia, the port of Rome, having seen Elba, the place of Napoleon's banishment for a short time, on our way. Here we leave more of our manufactures, and some of the French brandy, taking instead raw silk and marble. Naples is our next port of call, and our manufactured goods are lessening rapidly, brimstone and marble taking their place. We have now a long sail before us, as we are bound for Venice, at the head of the Adriatic. Stromboli is very active as we pass, and without fear either of Scylla or Charybdis, we pass through the straits of Messina, round the cape and northwards into the Adriatic. Venice retains many signs of its former greatness, but these are unnoticed in our haste to land more of our home manufactures, and take in Venetian wines, rice, silk, and cheese. We have called at our last port, and sail southwards past the Ionian Islands, the south of Greece, through the Archipelago, into the Dardanelles, the Sea of Marmora, to the Golden Horn of Constantinople, where our charter says we are to discharge the whole of our cargo.

5. Enumerate the chief productions of Trinidad, Victoria, and Ceylon, and give the dates at which these possessions were severally annexed to the dominions of England.

Trinidad.—Taken from Spain in 1797. Productions: sugar, molasses, rum, cocoa, and spices, including cloves, nutmegs, pepper, ginger, vanilla.

Victoria.—Discovered in 1802; settled in 1835; and became a separate colony in 1850. Productions: gold in large quantities, tin, iron antimony: wool, tallow, hides, are also exported.

Ceylon.—Coast provinces became British in 1796. The whole island became a crown colony in 1815. Productions: coffee, cinnamon, cocoanut (nut, oil, and fibre), rice, spices, precious stones.

6. Describe the positions of Cyprus, St. Helena, Borneo, Barbadoes, and Vancouver's Island, and give a full description of one of these islands.

Cyprus.—An island in the Levant 60 miles from the S. coast of Asia Minor, 35° N. lat. and 33° E. long.

St. Helena.—An island in the S. Atlantic, 1200 miles from the coast of Africa, 16° S. lat. and 6° W. long.

Borneo.—A large island S.E. of Asia; the district visited by British is in N., about 3° N. lat., and 114° E. long.

Vancouver's Island.—W. coast of N. America; 50° N. lat. and 125° W. long.

St. Helena has an area of 47 sq. miles, and is a high table-land bounded by precipitous cliffs, which are in many cases upwards of 1,000 feet high. In these cliffs there are numerous inlets, but all are inaccessible except those on the north-west. On one of these stands James Town, the capital and port of the island. It has a healthy climate, although it is within the tropics, and is of considerable importance to this country. It is a calling station for vessels from India which take the Cape route, and also a station for the vessels of our navy which cruise on the west coast of Africa. From 1673 to 1833 it was in the possession of the East India Company. In 1815 it became Napoleon's home and his place of sepulture in 1821. It is the see of a bishop, and has a population of about 70,000.

7. Name the mountains in which the Rhine, Volga, Mississippi, Amazon, Indus, Lena, and Niger rise, the seas into which they flow, and a few of the principal cities on the banks of the four first-named rivers.

River.	Source.	Towns on Banks.
Rhine.	Mt. St. Gothard, Alps.	Amsterdam (Amstel), Leyden, Utrecht, Arnheim, Cologne, Coblenz, Carlsruhe, Strasburg, Basle, Schaffhausen, Constance, Liechtenstein.
Volga,	Valdai Hills.	Astrakhan, Saratov, Nijni-Novgorod, Moscow, Samara, Kasan, Tver.
Mississippi.	Mississippi proper, in Lake Itaska, Minnesota, west of Lake Superior; Missouri, in Rocky Mts.	St. Paul, St. Louis, Memphis, Vicksburg, New Orleans; Jefferson City, Pittsburg, on tribs.
Amazon.	Andes.	Macapa, Barra, Obidos.
Indus.	Himalaya Mts.	
Lena.	Altai Mts.	
Niger.	Kong Mts.	

History.

8. Arrange in chronological order and give the dates of the following events:—The accession of George III., of Edward I., and of James I.; the battles of Culloden, La Hogue, and the Standard; the passing of the Act of Uniformity, the Septennial Act, and the Habeas Corpus Act; the deaths of Nelson, Wallace, Mary Queen of Scots, and Pitt.

Battle of the Standard	1138
Accession of Edward I.	1272
Death of Sir Wm. Wallace	1305
Death of Mary Queen of Scots ...	1587
Accession of James I.	1603
Act of Uniformity passed	1662
Habeas Corpus Act passed	1679
Battle of La Hogue	1692
Septennial Act passed	1716
Battle of Culloden	1746
Accession of George III.	1760
Death of Pitt, Earl of Chatham ...	1778
Death of Nelson	1805

9. Give a brief account of the conquest of Britain by the Romans; and name any distinguished Romans who died in this country.

The first real invasion of England took place in 55 B.C. and the following year. Tribute was exacted, but the Britons were left alone till 43 A.D., when Aulus Plautius was sent to this country by the Emperor Claudius. He succeeded in subduing the country south of the Thames. In 50 A.D., Caractacus, a British chief, was defeated and sent prisoner to Rome. Missionaries from Rome introduced Christianity into the island from A.D. 58 to 64, while in 61, Boadicea, the queen of the Iceni, the British tribes occupying Norfolk and Suffolk being defeated, poisoned herself. Julius Agricola was Governor from 78 to 84, and during these years he extended the conquest to the Firths of Forth and Clyde, fortifying his positions as he went, and for safety erecting a wall between these arms of the sea. The policy of the Romans was to civilize the people, to build towns, make roads, and enlarge the resources of the country The emperor Hadrian visited the country in 121, and built a wall from the Tyne to the Solway. The emperor Constantine died at York in 306 and Severus in 211; Caurausius also died at the same town in 297.

10. Enumerate, with dates, the chief events of the reign of Henry III., and give a brief sketch of that monarch's character as illustrated by the events of his reign.

Ratification of the Great Charter	1216
Defeat of Louis at Lincoln	1217
Henry succeeded to power	1223
French war	1225
Second expedition to France	1242
Meeting of Mad Parliament and passing of Provisions of Oxford	1258
Simon de Montfort defeated the King at Lewes	1264
Shire and borough representatives sent to Parliament	1265
Battle of Evesham	1272

Henry was free from the cruelty and vice of his father, but was too weak to be a successful ruler in the stormy times in which he lived. His weakness led to both expeditions to France, and his ease and love of spending money in pleasure prevented these expeditions from being successful. His incapacity for government is shown by the fact that the "Mad Parliament" took the power from him, and by the growth of the power of Parliament.

11. Write a short life of one of the kings who reigned in Scotland during the sixteenth century, and explain the claim of the house of Stewart to the throne of Scotland.

Mary, Queen of Scots, was the daughter of James V., and succeeded to the throne while an infant. To prevent a marriage with Edward VI., she was sent to France, where she married the Dauphin. On his death she returned to Scotland, in 1561. Educated as a Romanist, her habits angered the Scotch, roused to great enthusiasm for Protestantism by the preaching of John Knox. She married Lord Darnley, and by this means alienated the Earl of Moray. Darnley was estranged by her favouritism for Rizzio, and led the nobles who murdered him. In 1566 James VI. was born, and his birth was immediately followed by the death of Darnley, and Mary's marriage with Bothwell, who was strongly suspected of being his murderer. The nobles rebelled, and Mary was confined in Lochleven Castle. Thence she escaped, and after being defeated at Langside, she fled to England, where she was virtually a prisoner for eighteen years. For alleged complicity in plots against Elizabeth, she was beheaded at Fotheringay Castle, 1587.

The Stewarts' claim to the throne of Scotland was based on the fact that Robert II., the first of the line, was the son of Marjory Bruce, daughter of Robert Bruce. David, her brother, left no issue, and as she had married Walter, the Steward of Scotland, her son was the nearest heir, and succeeded to the throne.

12. Name the principal English statesmen in the reigns of Henry VIII. and Elizabeth, and write a brief life of one of them.

Cardinal Wolsey, Thomas Cromwell, Sir Thomas More, William Cecil (Lord Burleigh), Earl of Leicester, Earl of Essex, Sir Francis Walsingham.

Thomas Cromwell was the son of a prosperous blacksmith and brewer at Putney. He received a liberal education, and on his return from the Continent became a lawyer. In this capacity he attracted the notice of Wolsey, who employed him in the work of the dissolution of the monasteries. On the fall of Wolsey he retired to Esher, but soon returned to London, and as a Member of Parliament succeeded in defeating a bill of impeachment against Wolsey. He became a member of the Privy Council, and the instrument of Henry's extortions, as well as furthering his divorce with Catherine. Having considerable

leanings to the Protestant party, he urged a marriage with Anne of Cleves. When she arrived, Henry was greatly disappointed, and Cromwell lost favour. In a very short time he was arrested, proceeded against by bill of attainder, and executed for high treason, 1540.

13. Enumerate the chief events of the years 1688-9, and state briefly the constitutional changes which resulted in England.

Trial of the Seven Bishops; request of the nobility for the help of William of Orange; landing of William at Torbay; flight of James II.; meeting of the Convention, passing of the Declaration of Rights, and the acceptance of the English Crown by William and Mary; revolt in Scotland, ending in battle of Killiecrankie.

The constitutional changes resulting from the events of 1688-9 were that James was declared to have forfeited the Crown, and it was settled first on the children of Mary, then those of Anne, and, failing these, on William's children by any other wife, James's son being thus debarred from the succession. The quarrel between the people and the sovereign was effectually settled by its being clearly set forth that the king can alone neither make nor unmake any laws, and that the judges cannot be dismissed at the king's pleasure. Toleration was also secured for Dissenters.

14. Give some account of the causes of the War of American Independence, and mention in order the chief incidents of that war.

In order to obtain money to meet the expenses of the war with France and Spain (1763), proposals were made to tax paper used in America. Having no share in the government of England, the colonists refused to pay, and would buy no stamped paper. The Stamp Act was repealed, but shortly afterwards taxes were levied on tea, lead, glass, and paper. The Port of Boston was closed after cargoes of tea had been thrown overboard by some of the inhabitants. Petitions followed, and the quarrel lasted ten years. War broke out in 1775.

Chief Events:—

Battle of Bunker's Hill	1775
Invasion of Canada by Montgomery	1775
Boston evacuated	1776
Declaration of Independence	1776
Long Island and New York taken	1776
Capture of Philadelphia	1777
Surrender of Burgoyne at Saratoga	1777
Surrender of Lord Cornwallis at Yorktown ...	1781
Independence of States acknowledged	1783

15. Name sovereigns of France and Spain who were contemporary with Elizabeth, Charles II., and George III., and give a brief account of the foreign policy of Charles II.

England.	France.	Spain.
Elizabeth 1558—1603	Francis II. 1559—1560 Charles IX. 1560—1574 Henry III. 1574—1589 Henry IV. 1589—1610	Philip II. 1556—1598 Philip III. 1598—1621
Charles II. 1660—1685	Louis XIV. 1643—1715	Philip IV. 1621—1665 Charles II. 1665—1700
George III. 1760—1820	Louis XV. 1774 Louis XVI. 1789 Republic. Napoleon 1804—1815 Louis XVIII.	Charles III. 1788 Charles IV. 1788—1808 Ferdinand VII. Joseph Bonaparte 1814 Ferdinand restored 1814

Charles II. was always in want of money, and his foreign policy mainly hinged upon his ability to get it. He married Catherine of Portugal for her dowry, and sold Dunkirk to France for a small sum. In order to obtain command of the supplies he made war with Holland. He joined the Triple Alliance against France, but all the time was receiving pay from the French king. When this was known war was again made against Holland, which ended in the treaty of Nimeguen, 1678.

School Management.

Three hours allowed for this Paper and that on Music.

All the Candidates must answer Question 1, and may not answer more than *eight* other questions.

1. Write full notes on one of the following subjects:—

(1) Leather; (2) Mountains; (3) Joan of Arc; (4) A Railway.

(1) Leather.

Introduction.—Draw from children:—Necessity of clothing for different parts of the body, among others, feet; shoes made of leather; leather used for other purposes; then of different kinds of leather, and that leather is made from skins of animals.

What Leather is.—Skins of animals dried and prepared in different ways: of horse, cow, buffalo, bear, deer, sheep, goat, chamois, kid, calf. Strong skins made into thickest leather.

Manufacture.—Some children may have seen skins: *calcit* covered with hair outside, flesh and fat inside; these of no use and must be removed. Method of removing:—Skins placed in lime water, *unhairing* and *fleshing* knives then used, put into pits with oak bark and *tannin* (explain): gradually changed to brown colour. Now called *leather:* need *currying*—surface covered with oil, lampblack, tallow, to make pliable, and give black, smooth appearance.

Finer kinds of skins not tanned, but covered with alum and salt, then washed, dried, and made glossy on a cylinder.

Kinds of Leather and Uses.—

(*a*) *Thick leather*, for all heavy work, strong boots, machine bands, trunks, portmanteaus, etc.
(*b*) *Morocco*—bookbinding, purses, coach linings.
(*c*) *Roan*—bookbinding, slippers.
(*d*) *Russian*—bookbinding, purses.
(*e*) *Kid*—gloves, finer kinds of boots.
(*f*) *Calf*—books, boots, gloves.
(*g*) *Shamoy*—(wash leather; why?).

(Exhibit specimens of each kind, if possible, and elicit peculiarities.)

Whence skins obtained.—Animals having been named, children can name countries: Russia, Switzerland, Morocco, America, Cape Colony, India.

Where manufactured.—Bermondsey, Stafford, Walsall. (Show all places on map.)

(2) Mountains.

Introduction.—Notice locality in which school is situated: flat, hilly, very hilly, in valley, etc. Names given to high land: mountain, hill, down, etc.

Definition and Varieties.—Land rising considerably above the level of earth's surface.

Use map and show that some mountains are in

(*a*) *Ranges:* point out Andes, Himalayas.
(*b*) *Groups:* Cumbrian.
Or (*c*) Stand singly, *Isolated.*
And (*d*) Emit fire, smoke, etc.; *Volcanoes*: Hecla, Etna.

Draw on blackboard, sections of mountains to show character of *slope*, which affects surrounding country, and give names *summit*, and *base*, with explanations.

How formed.—Speak of probable former state of earth, its cooling, and collapse of crust, and edges overlapping, with Andes as illustration, thus accounting for rocky western slope; also of effects of earthquakes and subterraneous fires.

Uses.—Illustrations must be given and the uses elicited:—

(1) As boundaries, *e.g.*, Pyrenees, Ural.
(2) As affecting climate, making country warmer or colder, moist or dry, *e. g.*, India, Scotland, North America, Africa.
(3) For sources of rivers.
(4) For minerals.
(5) Surface as pasturage, or for growth of trees.
(6) Add beauty to a country, *e.g.*, Scotland, Switzerland.
(7) Dividing nationalities.

"Mountains interposed make enemies of nations,
That had else like kindred drops been mingled into one."

(3) Joan of Arc.

Introduction.—A description of the state of France in the time of Henry VI.: the almost complete overthrow of Charles, and his intentions with respect to the kingdom. Then the siege of Orleans.

Who she was.—A servant at an inn in Domremi, a town on the borders of Champagne and Lorraine (point on map). At time of becoming known, twenty-seven years of age, used to manual labour, and a skilled horsewoman; pious and attentive to her religious duties. Real name Jeanne Darc.

What she did.—Thought about her country's wrongs, believed herself inspired, determined to rescue Charles.

Her plan.—Presented herself to governor of Vancouleurs, got herself sent to Charles, picked him out from crowd, told him a secret known only to himself, described a sword by which she

meant to assist him, raise the siege of Orleans, and crown the king at Rheims—English were superstitious, and allowed her to enter Orleans, from which she made sorties and caused them to raise the siege (explain), 8th May, 1429. Went with Charles to Rheims, where he was crowned 12th July. Would have then gone home, but Charles detained her.

What became of her.—Remained with army till 1430, when she was taken prisoner at Compiègne by Burgundians, and given up to Bedford. Tried for sorcery and heresy, and her courage failing, confessed her revelations were impostures. Burnt alive in Rouen market-place, June 14th, 1431.

Her character and the results of her work.—Brave, pious, and patriotic; her country's deliverer, superstitious as other people of the time, but careless of danger so long as needed by her country; modest, retiring, and unambitious for herself.

The enthusiasm she roused ultimately led to the loss of nearly all the British possessions in France and the reinstatement of Charles in the sovereignty of nearly the whole of the country.

(4) A Railway.

Introduction.—Desire to visit friends in distant part of country; easiest method by the railway.

Origin of Railways.—Story of Stephenson: tramways with wooden rails. First railways, Stockton to Darlington, and Manchester to Liverpool.

Formation of a Railway.—Country surveyed (explain), shortest, best, easiest, or most practicable route chosen: levels taken (name and show as many as possible of instruments used), plans made, sections shown: contract let (explain).

Navvies employed (origin of word); ground levelled, drains made, cuttings formed, and hollows filled up or bridged over; work going on in several places at once.

Materials used.—Sleepers (why?) of wood; *chairs* (why so-called?) of iron; *rails*, of steel or iron, joined by *fishplates*. (Draw on blackboard: show joint and holes made so as to allow for expansion or contraction by heat or cold.)

Parts of Railway.—Stations (for passengers, and goods); at either end called the terminus (get other words), *up* and *down* lines (why? and show which is *up* and which *down*); *sidings*, *depots*, *signals* with cabins.

Rolling Stock.—Engines, carriages, trucks or waggons.

Uses. (*a*) Easy means of transit for passengers and goods.
(*b*) Helps to commerce and trade.
(*c*) Add importance to a place for above reasons.

Note.—The above is amply sufficient for a lesson. Other points, as persons employed, method of working, prevention of accidents, etc., would make up another lesson.

2. Name in progressive order of teaching, the apparatus required for lessons in geography, and show how you would give a conception of scale and proportion in map-drawing to young children.

The apparatus required for lessons in geography arranged in progressive order would be:—A blackboard and its accessories, a box of sand, some soft clay, and a sheet of white paper, a globe, a map, and text book. This order is given on the principle that *illustration* should accompany verbal explanation, and that the eye should aid the ear in the acquisition of geographical facts.

Illustration would precede explanation. Reference to different kinds of portraits which all children have seen would be made, and the blackboard would be employed to compare similar objects. From these illustrations would be deduced the conclusion that the same object may be represented by different sizes of lines of which all objects are formed. Lines to represent a yard, a mile, a degree, and multiples of these would then be made, and these applied to the dimensions of maps of different countries.

3. State the chief points to be noticed in giving a lesson on 'a river,' with the order in which each point should be introduced to the class. Illustrate your answers by some English or Scotch river.

The situation of the school would determine the order adopted. If near the mouth of the river, a *sail up the river* would probably be taken; if near the source of the river, a *walk down the banks* would be preferable. If away from any river, then the method adopted would be to illustrate by a shower of rain falling, and the different streams noticed joining each other, and forming a current in the street. Reference would then be made to the *hills*, as the *source* whence most rivers flow, (resemblance to house-tops pointed out,) the *course* down the valleys into which they flow and the streams from each, the different *feeders* or *tributaries* (resemblance to different streams from streets.) The *banks*, *bed*, *basin*, and *mouth* would then be noticed in turn, together with the *towns* on its banks. The river Thames might be used as an illustration. Its source, the Cotswold Hills, its tributaries along the course eastwards, the Windrush, Evenlode, Thame, Colne, Brent, Lea, Roding, on left bank; Kennet, Loddon, Wey, Mole, Darent, Medway, on right bank; the towns Oxford, Reading, Windsor, Eton, Richmond, Brentford, London, Greenwich, Woolwich, Chatham, Gravesend.

4. What plan would you follow in giving a description of some famous battle? Illustrate your answer by the Battle of Flodden *or* Waterloo.

A description of the causes of the war, the different contending parties, and the situation pitched upon as the place of battle would be briefly given. The latter would be illustrated as far as possible by a plan on the blackboard. Then would follow the chief events of the battle, with instances of striking bravery, and the result of the battle would be given with the ultimate benefits accruing.

Example.—French Revolution and death of Louis XVI. caused declaration of war against France, which lasted nearly twenty-two years. Rise of Napoleon, and results of Peninsular campaign noted, and Napoleon's conquests in Austria, Germany, etc., ending in confinement in Elba. His escape, and battles of Ligny and Quatre Bras. Both armies quartered on two gentle slopes near the village of Waterloo; in the hollow between lay the farmhouses of Hougomont and La Haye Sainte, round which the battle raged most fiercely. Napoleon tried to break the British ranks by shot and shell, and charges of cavalry. Repulse after repulse took place, till at last Napoleon's Old Guard, hitherto unconquered, made a furious onset, but wavered when met by the rush of the British Guards, broke and fled, pursued by the Prussians, just arriving to aid the British. Abdication, flight, surrender, and banishment of Napoleon followed.

5. Write out brief heads of a first lesson in 'simple subtraction with a series of progressive examples.

(1) *Meaning of subtraction.—Taking one number from another.* (Numbers are supposed to be known. Ball-frame to be used. Subtraction to be dependent on addition when done mentally.)

(2) *Examples in which the subtrahend is unvarying.*

Place ball-frame before class, and take 1 from 2, 1 from 3, 1 from 4, etc., up to 10: 1 from 2 leaves 1 because 1 and 1 are 2, etc.

When these have been learnt, questions without the use of ball-frame should be given.

(3) *Examples in which the minuend is unvarying* should next be given and treated as part two. 9 from 10, 8 from 10, etc.

(4) *Examples with varying* minuend and subtrahend are next to be given, *e.g.*, 2 from 9, 5 from 8, etc.

(4) *Blackboard* and then slates to be used, and examples of a similar character to above to be given on slates. Numbers up to hundreds may be given, where the principle of borrowing does not occur, *e.g.*—

10	8	72	47	98	736	830	770
9	4	21	34	26	215	220	370

6. Write out two or three problems in mental arithmetic requiring the application of three at least of the compound rules.

(1) A woman went to market with a sovereign in her pocket. She bought 4lbs. of beef at 10d., 2lbs. of sugar at 6d., ½ lb. of cheese at 9d. How much change had she for her other purchases?

(2) The wages of a man are 5s. a day, of a boy half as much; how much less than five pounds would two men and two boys earn in a week?

(3) A labourer earned 4s. on Monday, 5s. 6d. on Tuesday, and 3s. 6d. on each of the other days of the week. He pays 2s. 6d. a week for rent, and 1s. for schooling for his children; how much is left for his other wants?

7. Make and explain diagrams to illustrate the following:—

$\frac{1}{2}(\frac{1}{2}-\frac{1}{4})=\frac{1}{8}$.
$(\frac{1}{2}-\frac{1}{4})\div\frac{1}{2}=\frac{1}{2}$

(*a*)

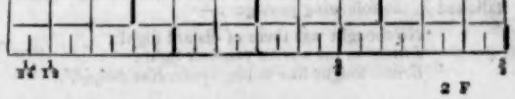


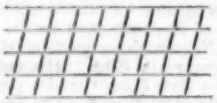
Diagram (*a*) shows that if a space be divided into three parts, and also into four parts, the difference between one of each of these parts is as much as one of the parts would be if the line were divided into twelve parts, and when one half of this difference is taken it is equal to $\frac{1}{24}$ of the whole space.

(*b*) The same illustration may be used.

$(\frac{1}{3}-\frac{1}{4})=\frac{1}{12}$. To divide the whole line by 1 would give $\frac{1}{12}$, but of $\frac{1}{3}$ of the line $\frac{1}{12}$ is the fourth part.

8. Explain fully the principles of Mulhauser's method of teaching writing; and write the word 'trustfulness' according to that method.

Mulhauser's method of teaching writing is founded on the principle that aid should be given to the learner in determining the height, distance, and inclination of the separate parts of the letters of which words are formed. For this purpose lines are ruled horizontally and diagonally in the writing books, the distance between the horizontal and diagonal lines being the same. The horizontal lines determine the height of the letters, and the diagonal their distance and inclination.



Definite heights are given to the letters, thus *h b l* are a *height* above the line, *t* half a height above the line, and so on.

Letters which descend below the line are regulated in the same way.

When the inclination, heights of letters, and distances are learnt, the diagonal and the horizontal lines are gradually removed, and the style of writing acquired is symmetrical, regular, and free.

9. Detail some of the advantages and disadvantages of teaching reading by the Alphabetic method.

The advantages claimed for the alphabetic method of teaching reading are that the correct form of spelling the word is learnt at the same time as the sound of the word which it represents; the analysis of a word into its component parts compels the eye to linger longer over the words, and the form is the better impressed on the memory, and ability to recall the sound is rendered greater the next time the word presents itself.

The disadvantages are that the same sounds of the letters are not always used in the words; that having to pay attention to the *parts* prevents the learner from attending to the whole word-sign; that progress is retarded by the child being able to revert to this method of spelling, and effort is not put forth to retain the sign; that it does not practically assist spelling, for the power to repeat words at sight does not depend upon spelling but upon frequent reading.

10. Define a 'sentence' in grammar, and illustrate your definition by original examples of simple, complex, and compound sentences relating to events in English history.

A sentence is the expression of a complete thought. When the sentence contains but one subject and predicate it is called a simple sentence.

When it contains, besides the principal subject and predicate, one or more subordinate clauses with subjects and predicates of their own, the sentence is called complex.

When two or more simple sentences are united by conjunctions the sentence is compound.

Simple.—William, Duke of Normandy, defeated Harold.
The Battle of Waterloo was fought in 1815.

Complex.—Harold hastened to the South of England when he had suppressed the rebellion of Tostig in the North.
George IV. was appointed Regent when his father was incapacitated by illness.

Compound.—James II. left the country in 1688, and the crown was conferred on William III. and Mary II.
The Wars of the Roses lasted thirty years, and it is said that during that period nearly a million lives were sacrificed.

11. Give short explanations suitable for children of the words italicised in the following passages:—

'No thought was there of distant flight;
Linked in the *serried phalanx* tight;
Groom fought like noble, *squire* like *knight*.'

'As day *declines*, *nature* recovers from this *languor* and exhaustion; the *insects* again *flutter* across the open glades, and the larger animals *saunter* away from under cover in the direction of the ponds and *pastures*.'

(*a*) *Linked*, joined together; *serried*, closely arranged; *phalanx*, company, body; *groom*, an attendant, chiefly employed to take care of horses; *squire*, the attendant or servant of a knight; *knight*, a titled soldier.

'The company was so closely arranged that masters and servants, nobles and common people fought side by side.'

(*b*) *Declines*, comes near its close; *nature*, in this instance used for animated life; *insects*, very small animals that creep or fly, as a bee, or fly; *flutter*, fly; *saunter*, to move quietly; *pastures*, feeding grounds.

'During the heat of the day the animals had gone under cover, and the insects had ceased to fly about in the sun, but as the heat grew less, towards the close of the day, the larger animals came slowly out of their shelter towards the feeding grounds, and the insects again began to fly about in the open spaces.'

12. Give examples of Kindergarten exercises that may be used to stimulate invention and imitation in young children.

Every gift in Kindergarten may be used to stimulate imitation. The teacher can use the gifts in different ways, *e.g.*, rolling the ball, placing the cube and the cylinder in different positions, making the common geometrical figures, doors, windows, rooms, houses, towers, columns, pillars, with the bricks of different sizes; with the box containing pieces of cardboard, triangles, prisms, articles of everyday use; with sticks, letters of different kinds, angles, triangles, gables, trees; with the plait-paper making different patterns, and the children can imitate readily.

With the third gift invention may begin to be stimulated. An infinite variety of figures will suggest themselves to the child's mind when a few have been imitated, and the same with the remaining gifts. A box of one kind has been made, the child invents another, longer, shorter, deeper, or all these together; a column has been shown, two, three, or more suggest themselves: one room has been made, the child goes to two or four; with sticks and peas when once the method has been shown of forming letters or words, then other words, other letters, and other figures suggest themselves, and invention is stimulated by every new figure shown.

13. Point out some of the uses of object lessons in infant schools, and illustrate your answer by short notes of a lesson on 'The Whale,' *or* on 'Iron.'

The uses of object lessons in infant schools are to awaken the intelligence, to train the eye, the ear, the touch, and mental powers, thus cultivating the perceptive and conceptive faculties. The imparting of information is a secondary use, the information given being a means rather than an end.

WHALE.

Introduction.—Seen fish in a shop (ling) as big as themselves; some much larger—the whale.

Size.—60 to 100 feet long (compare with school).

Thickness.—Show picture with man beside it, and draw a circle on board to show thickness compared with a man.

Parts of body.—Head, large and strange shape; *mouth*, wide and long (compare with room or table, or form): *eyes*, small; *nostrils*, on top of head; *tail* (draw shape on black board); *fins*, large.

Habits.—Floats often on water, why? needs to breathe, being warm-blooded; swims slowly, four miles an hour (boys run as fast), lives on small fish, catches them while swimming with open mouth, water runs out through whalebone in mouth.

Where found.—Cold seas (show picture of catching whales, and elicit danger from tail of fish, ice, etc.).

Uses.—Show *whalebone*—hand it to children and ask its colour and qualities—*blubber*, speak of oil in lamps, etc., and show how we depend largely for oil from blubber of whale.

14. Show that by the aid of a blackboard or other apparatus plain darning may be taught simultaneously to a large class.

The easiest way of explaining the method of darning to a large class is either by the use of Kindergarten paper, a ball frame without the balls, the blackboard, or the whole of them combined. The first stitches across a hole to be darned may be shown by lines drawn on the blackboard, or the bars across a ball-frame, or long strips of Kindergarten paper, then the cross stitches may be shown by coloured or white threads woven

in and out of the wires of the ball-frame, or by coloured papers woven in and out of the strips of paper already used. A whole class can see a frame fixed on the blackboard, or, if in a gallery, held in the hand on a table.

Domestic Economy.

Three hours allowed for this Paper.

Candidates are not permitted to answer more than *one* question in each section.

SECTION I.

Needlework.

1. Describe fully the following stitches, and say in what garments and materials they are commonly used, and how you would teach them to children:—*hemming, felling, backstitching, feather-stitching, i.e., coral-stitching.*

Hemming.—Turn in the edge of the material and double over a second time. Take up two threads of the main part of the material on the needle, and two of the turned-in hem, the needle being held diagonally, draw the thread through, and take up the bottom as before, leaving two threads of the material between each stitch.

Bottoms of calico and holland garments, and hemming on bands.

Felling.—When a seam has been made, the stitch used for hemming down the raw edges is called *felling*. Stitch as in hemming.

Used for all seams in all garments except flannel.

Backstitching.—Draw a thread to mark the direction the stitch is to take. Take up two threads of the cloth, then put in the needle in the same place as at first, taking up two threads behind and two before the working cotton.

Bands for neck or wrist, shirt fronts, and gussets.

Feather-stitching.—Fasten in the thread, stitch it diagonally on the material, holding it with the thumb, fasten down by a back stitch; stretch the thread in the opposite direction, and fasten as before, and so on alternately. Two or more stitches may be taken at the end of the diagonal thread.

Used for flannels instead of stitching, and in all places where stitching is used on other materials.

2. Describe the process of cutting out, and making a pinafore of six-years old, with exact measurements, and an account of the materials required.

An ordinary-sized child of six would require a pinafore of 22 to 24 inches in length.

Take one breadth of material (36 in.) 24 inches long, fold in four selvedge-wise, laying it on the table with the middle of the material uppermost on the right, mark off 2½ inches along the top and down the side of the left top corner, join by straight line, cut through four thicknesses along the straight line. Down the same side mark to 9 inches, and cut through slightly curved line for arm-holes. From top 2½ draw curved line to point two inches below right top corner, open, and lay on table with middle of pinafore to the right. Mark off from left hand corner 1½ inches down left side, and draw curved line; now cut the slopes along the curved lines, back and front.

Seam and fell shoulders, hem round armholes, bottom, and neck, the latter broad enough to take a tape; gather the front or leave plain as desired; if plain, sew on strings 9 inches from neck; if gathered, stitch on band at front long enough to tie behind.

SECTION II.

Savings and Investments.

1. State the annual income on which, in your opinion, a retired schoolmistress could live in comfort in her old age; and the methods of saving and investment in her days of full work and salary, by which she could provide that income on retirement.

The income required would depend greatly upon the place in which the retirement took place. In towns, where rents of rooms are high, more would be needed than in the country, where rooms are cheaper, and where living generally is cheaper than in town. An economical mistress being her own dressmaker would be able to enjoy a comfortable life on from £30 to £50 a year.

This sum can be obtained by mistresses at the present time in various ways—the chief by life insurance (the sum being paid after a certain number of years, or at death, if that previously occur), by the purchase of a deferred annuity; by savings placed in savings banks, or by judicious investments in safe concerns yielding a little more interest than the Post Office Savings Bank.

A mistress saving £12 10s. per year could purchase with it an annuity of £50 a year, payable after reaching the age of 50, supposing she commenced at the age of 21, and continued her payments to that time.

2. On what weekly wages can an artisan maintain in comfort himself, his wife and four children between the ages of four and ten; and in what proportion should he distribute those wages in rent, food, clothing, education of his children, recreation and savings?

A town artisan can earn and live comfortably under the conditions prescribed in the question on 35s. a-week.

He would need for rent 5s. 6d.; food, 19s. 6d.; clothing 5s. education of his children 1s.; recreation 1s.; and savings 3s.

SECTION III.

Food—its Ingredients.

1. What effect is produced on the human body by food containing large quantities of the following substances respectively—(*a*) sugar, (*b*) lime, (*c*) salt, (*d*) animal oils?

(*a*) Large quantities of sugar serve to increase [illegible]t of the body; they also tend to increase the weight of the body; being stored up in the body in the shape of fat, the bulk of the body is increased.

(*b*) Lime is necessary for the purpose of giving hardness to the bones. Too much of it, however, affects the digestive organs.

(*c*) Salt in large quantities produces scurvy.

(*d*) Animal oils increase the weight of the body, produce great heat, disarrange the digestive organs, and are often the cause of indigestion and biliousness.

2. State fully what are the objections to a diet either exclusively vegetable or exclusively animal.

The substances required as food by the body are carbon, hydrogen, oxygen, nitrogen, water and salts of alkalies, earths and metals. No substance can serve as food permanently, which does not contain nitrogen. The composition of most articles of food is such that it contains one or more of these substances in excess, and any of them alone would not supply those elements necessary for forming flesh, or giving heat to the body. In order, therefore, that the organs of the body may not be overtaxed in obtaining the materials for either of these purposes, a mixed diet is necessary. For example, if a person is fed on fatless meat, in order to obtain sufficient carbon he would require to eat five to six pounds, while one pound would supply him with sufficient nitrogen, and his digestive organs would require to do four times the amount of needful work. He would be able to get the necessary carbon and nitrogen from 2 lbs. of bread, and ¾ lb. of meat. If he attempted to get the necessary amount of nitrogen from a potato diet he would need 10 or 12 lbs. daily, while 3 lbs. would be sufficient with ¾ lb. of meat. On the other hand, if a person tried to live only on flesh-forming food, he might die in consequence of the loss of vital power in getting the necessary amount of carbon.

SECTION IV.

Food—its Preparation.

1. Describe the efficient modes of cooking potatoes; give your opinion as to the merits of each, and say for what dish of meat each mode of cooking them is most suitable.

Potatoes may be boiled, steamed, roasted or baked, and fried. Potatoes may be boiled in two ways, with or without the jackets: the former is the more economical and better, as the most nutritious part of the potato is said to lie close to the skin.

Method: clean and brush well, put in saucepan with cold water, boil slowly, add a little salt occasionally. Probe, and when tender, pour off the water and dry thoroughly.

Boiled:—Peel carefully, place in cold water, boil steadily, when soft pour off water, place by fire, shake occasionally, and cover with napkin, instead of pan-lid for a short time.

Roasted or baked:—Wash well and clean with brush; place in oven and bake till enough, serve on a hot napkin.

Steamed:—Pare neatly, wash in cold water, put them in steamer which fits above pan of boiling water. When pierced easily by a fork they are done, shake steamer for a minute and serve hot.

Fried:—Slice after paring, and fry in dripping. When brown and crisp drain on a towel and serve in a deep dish. Boiled or steamed to any kind of meat; roasted to roast meat or fish; fried potatoes to steaks; boiled and mashed potatoes to hashes, minced collops, or stews.

2. Give an account of the materials, preparation, and cooking of an economical and wholesome dinner for a schoolmistress living alone.

Either stewed steak and potatoes, and suet pudding; or minced collops and boiled rice would make a readily-prepared, economical, and wholesome dinner.

Take ½ or ¾ lb. of steak, and put in pan with cold water and a few drops of vinegar; cut up a carrot or a leek or an onion; place pan where it will simmer all morning during school hours. In another pan place a small suet pudding prepared as follows: two ounces of suet chopped fine, mixed with ½ lb. of flour, a little baking powder and salt, into a paste with milk or water, tie in well-floured cloth; place where it will boil all morning. Immediately on coming home place potatoes pared before school in steam pan above pudding, put steak on fire and let it boil, adding pepper and salt.

Serve pudding with jam, sugar, butter or treacle, according to taste. Finish with a little cheese if desired. Total cost, 10d. to 1s.

SECTION V.

Rules for Health.

1. Mention any respects in which the modern fashion of female dress is injurious to health, and show in what way each foolish practice in dressing produces its bad effects.

The great prevalent evils of female dress at present in vogue are those of tight-lacing and the wearing of high-heeled small boots. The former practice hinders the work of the respiratory and digestive organs, gives a malformation to the ribs, and is the source of diseases of the lungs, indigestion, and biliousness.

High-heeled boots throw the body forward, and put the greatest weight on the toes, which are forced into a narrow compass at the pointed toe of the boot. Corns, partial lameness, inability to take much walking exercise, and an ungainly gait are the consequences. The thin soles worn are also the cause of coughs and colds, and diseases which follow.

2. Give plain rules for the preservation of health for a pupil teacher (*a*) who lives in the country a mile from her school, and (*b*) for a pupil teacher in London living a few doors from her school.

To both.—Attend regularly to personal cleanliness and to cleanliness of clothing. Secure regularly at least eight hours' sleep, and keep regular hours.

(*a*) Start at least 20 minutes before the time you are expected at school, so as not to overheat yourself with walking; wear strong boots to protect the feet, and be prepared for changes of weather by carrying with you an umbrella, and a thin waterproof, which will serve either as a wrapper from cold, or a preventative of getting wet.

(*b*) Take half an hour's walking exercise before going to school in the morning. If the weather is too wet for it, use the dumbbells and backboard for half that time. Take a similar walk after an interval of rest in the afternoon.

3. What would you do before the doctor came if a child in your school (*a*) was badly scalded, (*b*) had fainted, (*c*) had cut his arm above the elbow.

(*a*) Avoid exposure to the air. Cover the injured part with flour, and this with a sheet of cotton wadding, or soft linen rag; keep the child quiet and warm.

Or cover with soft linen rag after pouring on oil, or spirits of turpentine if the skin is not broken.

(*b*) Take into open air, lay the child on his back, unfasten all garments about wrists and neck, keep the head a little raised, let him smell smelling-salts, rub the hands gently to help circulation, give a little warm coffee if it can be swallowed, and bathe the temples, forehead, and hands with water.

(*c*) Press the thumb tightly above the wound, while another ties a handkerchief tightly round the arm, and twists it still tighter by means of a cane or stick pushed underneath the handkerchief. The flow of blood will thus be checked and the child saved from bleeding to death.

SECTION VI.

Clothing and Washing.

1. Describe the modes of washing, drying, and getting up the different articles which would go into the tub on washing day in a labourer's cottage.

Sort first, dividing into three heaps, white articles, flannels, towels and aprons. Soak in soft water in which soap has been boiled, rubbing with soap the dirty places. Place in washing-machine (if any—or poss-tub), and wring out of the dirty water. Rub the dirty parts again with soap, and one part against another or brush with a hard brush, place in pot and boil with soap and soda; wring out of a clean water in machine or by hand and hang out to dry.

Flannels are rubbed through the second water of the white clothes, passed quickly through a clean water, and hung out at once to dry to prevent shrinking.

Next come the dirty towels, working aprons, and other coarse articles, which after rubbing will need a good boiling with soap and soda. The man's clothes being heavy and very dirty will come last, and will be treated in the same way as the towels. When nearly dry pass several times through mangle (if any), and iron with a hot iron. Linen cuffs and collars to be ironed wet, out of cold water starch.

2. Give an account of the price, material, colour, and making up of a neat dress for your own summer wear in school, and say how it should be washed and worn so as to last as long as possible.

Suitable washing materials for dresses for summer wear are prints, hollands, pompadours, and galateas. The prices of these range from 6½d. to 1s. 3d. per yard. They may be had in any colour and pattern, the most suitable perhaps being blue and white, or brown and white. Ten to twelve yards will be required, and a neat, elegant style of making-up known as a princess' robe, of walking length, is a very suitable one for school wear. Whichever material is chosen, the dress should be washed carefully in moderately warm water, without soda or washing powder, and dried in the shade, after being wrung out in a little starched water. It should be mangled first, and well ironed. To last as long as possible, care should be taken not to get it wet, inked, or torn on forms or desks at school. It should be worn during school hours only.

ANSWERS TO
Pupil Teachers' Examination Papers.

SEPTEMBER 30TH, 1882.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find by practice what £17 18s. 1d. per day will amount to in a solar year of 365 days 5 hrs. 48 min.

		£	s.	d.
1 day =		17	18	1
				365
365 days =		6535	0	5
4 hours = ⅙ of 1 day =		2	19	8½
1 ,, = ¼ of 4 hrs. =		0	14	11 1/12
30 min. = ½ of 1 ,, =		0	7	5 11/12
15 ,, = ½ of 30 min. =		0	3	8 5/24
3 ,, = ⅕ of 15 ,, =		0	0	8 17/120
		£6539	6	11 53/120 Ans.

2. If the rent of a farm of 55 acres be £151 6s. 8d., what should be the rent of another farm containing 36 acres 3 roods if 11 acres of the former be worth 8 acres of the latter?

55 ac. : 36¾ ac. } ::£151¾ : rent
8 : 11

$$\frac{£454 \times 36\frac{3}{4} \times 11}{3 \times 55 \times 8} = \frac{£424 \times 147 \times 11}{3 \times 320 \times 8} = \frac{£227 \times 49}{80} = £139 \text{ os. } 9\text{d.}$$

3. Calculate, by practice, the difference between 540½ tons at £20 16s. 8d. per ton, and three thousand and sixty-seven pounds at seven shillings and sevenpence three-farthings per pound.

	£	s.	d.
(*a*) Value of 540½ at £1 =	540	5	0
			20
,, ,, £20 =	10805	0	0
,, ,, 10s. = ½ at £1 =	270	2	6
,, ,, 6s. 8d. = ⅓ ,, =	180	1	8
	£11255	4	2

	£	s.	d.
(*b*) Value of 3067 at £1 =	3067	0	0
,, ,, 5s. = ¼ at £1 =	766	15	0
,, ,, 2s. 6d. = ½ at 5s. =	383	7	6
,, ,, 1½d. = 1/160 at 2s. 6d. =	19	3	4½
,, ,, ¾d. = ½ at 1½d. =	3	3	10½
	£1172	9	9½

∴ The difference = £11255 4s. 2d. − £1172 9s. 9½d. = £10082 14s. 4½d. Ans.

4. How many yards of cloth at 6s. 7½d. a yard will cost the same sum as 371 yards at 6s. 9d. a yard?

6s. 7½d. : 6s. 9d. :: 371 yds. : ?
or or
159 halfd. 162

$$\frac{371 \text{ yds.} \times 162}{159} = 378 \text{ yds. Ans.}$$

FEMALES.

1. Make out the following bill:—
189 yards of cloth at 15s. 6d. per yd.
40½ yards of diaper at 1s. 7d. per yd.
64 yards of muslin at 12s. 6d. per yd.
72 yards of cambric at 5s. 6d. per yd.
14 hats at 12s. 6d. each.
19 umbrellas at 18s. 7½d. each.

	£	s.	d.
189 yds. at 15s. 6d. =	146	9	6
40½ ,, 1s. 7d. =	3	4	1½
64 ,, 12s. 6d. =	40	0	0
72 ,, 5s. 6d. =	19	16	0
14 hats at 12s. 6d. each =	8	15	0
19 umbrellas at 18s. 7½d. each =	17	13	10½
	£235	18	6. Ans.

2. Find the cost of 14,865 articles at 13s. 6½d. each.

	£	s.	d.
Cost of 14,865 arts. at £1 each =	14865	0	0
,, ,, ,, 6s. 8d. = ⅓ at £1 =	4955	0	0
,, ,, ,, 6s. 8d. = ⅓ ,, £1 =	4955	0	0
,, ,, ,, 2½d. = 1/32 at 6s. 8d. =	154	16	10½
	£10,064	16	10½

3. What would be the cost of 16 yds. 2 ft. 10 in. of cloth at 2s. 6½d. per yard?

	£	s.	d.
Cost of 1 yd. =	0	2	6½
			16
,, 16 yds. =	2	0	8
,, 1⅓ ft. = ⅓ of 1 yd. =	0	1	3⅓
,, 1 ft. = ⅓ ,, =	0	0	10½
,, 4 in. = ⅓ of 1 ft. =	0	0	3 7/11
	£2	3	0 8/11. Ans.

4. Find the value of 70,014⅜ at £1 13s. 8d. each.

	£	s.	d.
Value of 70,014⅜ at £1 each =	70014	7	6
,, ,, 6s. 8d. = ⅓ at £1 =	23338	2	6
,, ,, 6s. 8d. = ⅓ at £1 =	23338	2	6
,, ,, 4d. = 1/20 at 6s. 8d. =	1166	18	1½
	£117,857	10	7½

Grammar.

1. Point out and parse all the verbs and adjectives in the following:—

'O Brignall banks are wild and fair,
And Greta woods are green,
And you may gather garlands there
Would grace a summer queen.'

Brignall—dist. adj., limiting 'banks.'
are—irreg. intrans. verb, *am, was, been*, indic., pres. indef., 3rd pers. plur., agr. with 'banks.'
wild—predic. adj., qual. 'banks.'
fair— ,, ,, ,, ,,
Greta—dist. adj., limiting 'woods.'
are—same as before, agr. with 'woods.'
green—pred. adj., qual. 'woods.'
may gather—reg. trans. verb, potential, pres. indef., 2nd pers. plur., agr. with 'you.'
would grace—reg. trans. verb, potential, past indef., 3rd pers. plur., agr. with (*which*).
summer—dist. adj., qual. 'queen.'

2. Give four examples to show how the verb agrees with the nominative in person and number. N.B.—Do not simply give the examples, but explain also how they illustrate the rule.

The verb agrees with its subject in number and person; that is, a verb must take the *form* or *termination* denoting the same number and person with its subject. For example: we say, 'I *am*,' but 'thou *art*,' 'he *is*,' and 'we *are*.' The subjects 'I,' 'thou,' 'he,' and 'we' cannot be substituted for one another before these words without injuring the concord.

3. Give some rules for forming the plurals of nouns, with examples.

(1) The plural is commonly formed by adding *s* to the singular, as book, books.
(2) Nouns ending in *s, sh, ch* (soft), *z, x*, or *o* (preceded by a consonant), take *es*, as Miss, Misses; brush, brushes; match, matches; topaz, topazes; fox, foxes; hero, heroes.
(3) Nouns ending in *y* after a consonant or *u* change *y* into *ies* in the plural, as lady, ladies; soliloquy, soliloquies.
(4) Nouns ending in *f* or *fe* change *f* or *fe* into *ves*, as loaf, loaves; life, lives; (staff takes staves.)
(5) Man, with its compounds, takes *men*; foot, feet; goose, geese; die, dice (for gaming); child, children; ox, oxen; mouse, mice; tooth, teeth; brother, brothers, or brethren.

Geography.

Answer Nos. 1 *and* 2; *and then No.* 3 *if you have time.*

1. What is meant by an *Indented coast?* Give examples in Great Britain and Ireland.

An indented coast is one which is broken up by arms or inlets of the sea. For example, the West and North of Scotland is so much indented by long inlets or lochs, as they are called, that no place is more than forty miles from the sea. The North and West coasts of Ireland are almost as much broken as the same coasts in Scotland. The West and South coasts of England are also more indented than the East coast.

2. What is meant by *watershed* or *water-parting?* Give examples in Great Britain, and show, by the courses of rivers, that there is a real *parting* of the waters.

Watershed and *waterparting* are two words belonging to the supply of water to rivers. A waterparting is the spot or line at which the surface-water of a mountain, hill, or swelling ground parts, and begins to flow down the slope on each side. Some mountains have a ridge almost as sharp as that of a roof, others are more irregular. Some undulating ground is pretty flat on the whole, and it is difficult to say by the eye where the waterparting is; but water will always find its own level, and there is always a line at which the water will, of itself, flow down the one side or the other, and the line, straight or crooked, is the waterparting. The waterparting being the ridge or highest line between the streams, the watershed is the whole ground between the waterparting and the stream.

The Pennine chain extends from the western extremities of the Cheviots to the Peak of Derby, and forms the great water-parting of the North of England. It sends off to the North Sea, the Tyne, Wear, Tees, Yorkshire Ouse, and the left affluents of the Trent; and to the Irish Sea, the Eden, Lune, Ribble and Mersey.

The Cheviot and Lowther Range extends from the borders of England to Loch Ryan in Wigtownshire, and forms the great water-parting of the South of Scotland, separating the basins of the Tweed and Clyde from those of the Solway and Tyne.

3. Name in order the counties of Wales, with the chief towns of each.

If you can, draw a plain map (without marking mountains or rivers) to illustrate your answer.

Flint—Mold, Holywell, Flint. *Denbigh*—Denbigh, Wrexham. *Caernarvon*—Caernarvon, Bangor. *Anglesea*—Holyhead, Amlwch. *Merioneth*—Bala, Dolgelly. *Montgomery*—Montgomery, Welchpool. *Cardigan*—Cardigan, Aberystwith. *Pembroke*—Pembroke, Haverfordwest. *Caermarthen*—Caermarthen, Llanelly. *Glamorgan*—Cardiff, Swansea, Merthyr Tydvil. *Brecknock*—Brecon. *Radnor*—New Radnor.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Diabolic*.

Write, in small hand, as a specimen of copy-setting, *Bolingbroke was destined to be the sport of Fortune.*

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the value of $(\frac{3}{5}-\frac{2}{7}+\frac{1}{2}-\frac{1}{6}+\frac{1}{3})\div(\frac{3}{5}-\frac{1}{4}+\frac{2}{3}-\frac{1}{7})$.

$$\frac{560-720+315-420+504}{2520}\div\frac{280-105+252-60}{420}=$$

$$\frac{179-1140}{2520}\div\frac{532-165}{420}=$$

$$\frac{239\times420}{2520\times367}=\frac{23}{1101}\quad\text{Ans.}$$

2. Reduce 17 cwt. 3 qrs. 7 lbs. to the decimal of three-quarters of a ton, and multiply the result by 21·3.

(*a*) $\frac{17\text{ cwt. }3\text{ qrs. }7\text{ lbs.}}{\frac{3}{4}\text{ ton}}=\frac{1995\text{ lbs}}{1680\text{ lbs.}}=\frac{19}{16}=\underline{1{\cdot}1875}$

(*b*) $1{\cdot}1875\times21{\cdot}\dot{3}=1{\cdot}1875\times\frac{64}{3}=\frac{19}{3}=\underline{25{\cdot}\dot{3}}$ Ans.

3. The price of gold being £3 17s. 10½d. per oz., find the price of ·0013 of an oz.

$$£3\ 17s.\ 10\tfrac{1}{2}d.\times{\cdot}0013=934\tfrac{1}{2}d.\times{\cdot}0013$$

$$=\frac{1869d.\times13}{20000}$$

$$=\frac{24297}{2}$$

$$=\underline{12\tfrac{1457}{2000}d.}\quad\text{Ans.}$$

4. A train going at the rate of 16½ miles an hour, travels a certain distance in $4\frac{7}{12}$ hours, how long would a train going at the rate of 20¾ miles an hour be in travelling the same distance?

20¾ mls. : 16½ mls. :: $4\frac{7}{12}$ ho. : time.

$$\frac{55\text{ho.}\times84\times8}{12\times5\times165}=\frac{44}{12}\text{ho.}=\underline{3\text{ho. }44\text{min.}}\quad\text{Ans.}$$

FEMALES.

1. A field of 12 acres having 120 stalks to each square yard, and 70 grains to each stalk, produces wheat to the value of £96 16s.; what will be the worth of the produce of 800 square yards, having 175 stalks to the square yard, and 45 grains to each stalk?

58,080 yards : 800 yards
120 stalks : 175 stalks
70 grains : 45 grains
:: £96 16s. : ?

$$\frac{1936s.\times800\times175\times45}{58,080\times120\times70}=25s.=\underline{£1\ 5s.}\quad\text{Ans.}$$

2. If I pay 1s. 3d. for 6 lbs. 14 oz. of bread when wheat is 4s. 9d. per bushel, what must I pay for 23 lbs. 12 oz. when wheat is 5s. 5d. per bushel?

6 lbs. 14 oz. : 23 lbs. 12 ozs.
or or
110 oz. : 380 ozs.
57d. : 65d.
:: 15d. : ?

$$\frac{15d.\times380\times65}{110\times57}=\frac{4940}{627}d.=\underline{4s.\ 11\tfrac{113}{627}d.}\quad\text{Ans.}$$

3. I spend twelve guineas in thirty-five days, and save £100 a year, what must I earn in a year?

35 days : 365 days :: £12 12s. : expenditure

$$\frac{252s.\times365}{35}=2628s.=£131\ 8s.$$

∴ he must earn £131 8s. + £100 or £231 8s. Ans.

4. An income of £3827 12s. 6d. is taxed at the rate of 7d. in the pound; how much clear income will remain?

233d. is clear income out of every 240d.

∴ 240d. : 233d. :: £3827½ : clear income

$$£\frac{30,621\times233}{240\times8}=£\frac{7133493}{1920}=\underline{£3715\ 19s.\ 8\tfrac{3}{4}d.}\quad\text{Ans.}$$

Grammar.

1. 'The reverend pile lay wild and waste,
Profaned, dishonoured, and defaced.
Through storied lattices no more
In softened light the sunbeams pour;
For dark Fanaticism rent
Altar, and screen, and ornament.'—SCOTT.

(*a*) Point out and parse all the adverbs and prepositions in the above.

(*b*) How do you know that the word 'for' in the above is not a preposition?

(*a*) *no more*—adv. phrase modif. *pour*.
wild and *waste*—adj. used adverbially.
profaned, *dishonoured*, and *effaced*—parts. used adverbially.
through—prep. relating 'pour' and 'lattices.'
in—prep. relating 'pour' and 'light.'

(*b*) 'For' is not a preposition, because it does not show any relation between a noun, a verb, or an adjective, and a substantive or substantive phrase or sentence. It introduces a subordinate adverbial sentence of cause, and is therefore a subordinating conjunction.

2. The prepositions *after*, *on*, *within*, and *without* are sometimes used as adverbs. Give examples, four, in which they are used as prepositions, and four in which they are used as adverbs.

Prepositions.

(*a*) You shall ride *after* us.
(*b*) The examination takes place *on* Saturday.
(*c*) The reckoning was *within* the mark.
(*d*) Students do not succeed *without* perseverance.

Adverbs.

(*a*) We shall go first and you can come *after*.
(*b*) Ride *on!* ride *on* in majesty.
(*c*) They were heard singing *within*.
(*d*) Around the flaming pile we sat,
While the wolves howled loud *without*.

3. Decline the pronouns He and Who.

Sing.	Plur.	Sing.	Plur.
Nom. He	They	Nom. Who	Who
Poss. His	Theirs (their)	Poss. Whose	Whose
Obj. Him	Them	Obj. Whom	Whom
(Dat. Him)	(Dat. them)		

Geography.

Answer either Q. 2 or Q. 3, not both.

1. Draw a map of the coast-line from Dantzic to Bordeaux, marking river-mouths, capes, bays, and islands near the coast. Insert the lines of latitude and longitude.

2. Name the chief towns of Germany, describing the situation and general character of each.

Berlin is situated on the Spree, an affluent of the Havel. It is the capital of the German Empire, an elegant city famous for the variety and extent of its manufactures. It is the great centre of intellectual development in the North of Germany.

Breslau is the second city in Germany in point of population. It is situated on the Oder, has a large trade, extensive manufactures, and is the seat of a university.

Cologne is the third city in Prussia, and the most important in the western division of the kingdom. Its position on the Rhine gives it great commercial facilities. Noted for its Cathedral and distilled waters.

Königsberg, a strongly fortified city on the Pregel, near its mouth in the Frische Haff, is noted for its manufactures, ship-building, and trade in grain.

Dantzig, a fortified city near the mouth of the Vistula, is one of the greatest corn-shipping ports in the world.

Magdeburg, the strongest fortress in the kingdom, has great trade, which is facilitated by numerous steamers on the Elbe.

Frankfürt, formerly a free city, is a populous commercial place on the Main, now noted for its banking transactions.

Hanover is a well-built trading and manufacturing city on the Leine.

Stettin, a fortified city at the mouth of the Oder, and next to Dantzig, the chief sea-port of the kingdom.

Coblentz, at the confluence of the Rhine and Moselle, the former of which is crossed here by a bridge of boats. On the opposite bank of the Rhine is the formidable fortress of Ehrenbreitstein.

Hamburg, on the estuary of the Elbe, is the most important commercial city on the Continent.

Bremen, a free city on the Weser, second to Hamburg as a seat of German commerce, is the great port for emigration to America.

Dresden on the Elbe, over which there is a magnificent bridge a quarter of a mile long. It is a fine city with manufactures of China and porcelain.

Munich (München), in the midst of a sterile plain, is by far the most populous city in South Germany. Its painting and sculpture are unrivalled in Germany.

3. Trace minutely (in words) the courses of the Rhone and the Po.

The *Rhone*, a large and rapid river of France, rises in Switzerland, five miles from the source of the Rhine, and expands into the Lake of Geneva, issuing from which it forms the boundary between Haute-Savoie and Ain, and Ain and Isère. From Lyons its course is southerly, and after passing Vienne, and Valence, and Avignon, it enters the Mediterranean by four mouths.

The *Po*, the largest river in Italy, issues from Monte Viso, and traversing the plains of Piedmont and Lombardy from west to east, discharges itself after a course of about 350 miles into the Adriatic by several mouths.

History.

1. What sovereigns reigned between 1066 and 1189? Give dates as well as names.

		A.D.
Harold II.	began to reign	1066
William I.	,,	1066
William II. (Rufus)	,,	1087
Henry I.	,,	1100
Stephen	,,	1135
Henry II.	,,	1154-1189.

2. How long did William and Mary fill the throne? Tell when each of them died.

			A.D.		
William III.	reigned from		1689	till	1702
Mary II.	,,	,,	1689	,,	1694.

3. Make a list of our sovereigns from 1702 to the present time, with dates.

		A.D.
Anne	began to reign	1702
George I.	,,	1714
George II.	,,	1727
George III.	,,	1760
George IV.	,,	1820
William IV.	,,	1830
Victoria	,,	1837.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Disobliging*.

Write, in small hand, as a specimen of copy-setting, *Bolingbroke was destined to be the sport of Fortune.*

Composition.

Write from memory the substance of the passage read to you by the Inspector.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed for this Paper.

Arithmetic.

MALES.

1. Find the simple interest on £215 12s. 6d. for 3 years 73 days at 4½ per cent. per annum.

$$£215\tfrac{1}{2} \times 3\tfrac{1}{5} \times \frac{4\tfrac{1}{2}}{100} = \frac{£1725 \times 16 \times 9}{8 \times 5 \times 200}$$
$$= £\frac{345 \times 9}{100}$$
$$= £31\ 1s. \quad \text{Ans.}$$

2. In a school there are 371 boys, 233 girls, and 256 infants. What per centage of the whole school is there in each department? (Correct to two places of decimals.)

Total in school = 371 + 233 + 256 = 860

860 : $\left\{\begin{matrix}371\\233\\256\end{matrix}\right\}$ :: 100 $\left\{\begin{matrix}43{\cdot}139 & \text{per centage of boys.}\\27{\cdot}09 & \text{,, girls.}\\29{\cdot}76 & \text{,, infants.}\end{matrix}\right.$

3. Find the value of £¼ per cent. on £150 10s. − 6s. 3d. per cent. on £200 10s. + £3½ per cent. on £5060 10s.?

$$\frac{850{\cdot}5 \times \frac{1}{4}}{£\ 100} = \frac{8{\cdot}505}{8} = £\ 1{\cdot}063125$$
deduct $$\frac{00{\cdot}5 \times \frac{1}{16}}{£\ 100} = \frac{10{\cdot}025}{16} = \ \ {\cdot}6265625$$
$$\text{Add } £\frac{5060{\cdot}5 \times 7}{200} = \frac{354{\cdot}234}{2} = \ \ {\cdot}4365625$$
$$177{\cdot}1175$$
$$177{\cdot}5540025$$
$$= £177\ 11s.\ 0\tfrac{11}{20}d. \quad \text{Ans.}$$

4. If a man pays the same amount of income-tax when it is raised from 6d. to 9d. per £1, by how much per cent. has his income diminished?

9d. : 6d. :: £100 : per centage on which tax is paid

$$£\frac{100 \times 6}{9} = 66\tfrac{2}{3}$$

∴ the income has diminished 33⅓ p. c.

FEMALES.

1. Find what quantity multiplied by ⅔ of ½ of 3½ gives a result equal to ⅞.

The No. $= \frac{7}{8} \div (\frac{2}{3} \text{ of } \frac{1}{2} \text{ of } \frac{7}{2})$

$$= \frac{7 \times 3 \times 5 \times 0}{9 \times 2 \times 4 \times 7} = \frac{0}{504} \quad \text{Ans.}$$

2. Required the value of $1\frac{1}{3}+\frac{1}{5}$ of $\frac{1}{4}\frac{1}{1}+\frac{4}{5\frac{3}{10}}$.

$$\text{Value}=\tfrac{4}{3}+\tfrac{10}{51}+\tfrac{4}{51}$$
$$=\frac{68+164+40}{51}=\tfrac{272}{51}=\underline{5\tfrac{17}{51}}.\ \text{Ans.}$$

3. A person possessed of $\frac{3}{4}$ of a coal mine sells $\frac{4}{5}$ths of his share for £2,000, what is the whole mine worth?

$\frac{3}{4}$ of $\frac{4}{5}$: 1 :: £2000 : worth of mine.

$$\frac{£2000\times5\times4}{3\times2}=\underline{£6,666\ 13s.\ 4d.}\ \text{Ans.}$$

4. A can do a piece of work in 5 days, B in 6, and C in 7; how much of it can they do jointly in 2 days?

A does $\frac{1}{5}$ in 2 days, or $\frac{2}{5}$
B " $\frac{1}{6}$ " " $\frac{2}{15}$
C " $\frac{1}{7}$ " " $\frac{2}{7}$

∴ A, B, and C can do $\frac{4}{5}\frac{1}{5}$ or they are able to do the whole and $\frac{1}{1}\frac{1}{5}$ more in the two days.

Grammar.

1. 'Not his the nerves that could sustain
Unshaken, danger, toil, and pain;
Yet this meek lover of the lyre
Nursed one true spark of noble fire;
Against injustice, fraud, or wrong,
His blood beat high, his hand was strong.'—SCOTT.

(*a*) Supply the verb in the principal sentence, and show why it is a principal sentence.

(*b*) Point out the subordinate sentence in the above, and state to which class of subordinate sentences it belongs.

(*c*) Point out all the words in the above that are in the objective case and explain their government.

1. (*a*) and (*b*) 'Not his (were) the nerves' is the principal sentence, because it contains the main idea; '*that could sustain* pain' is a subordinate *adjective* sentence, and qualifies the noun 'nerves.'

(*c*) *Danger, toil,* and *pain,* are abstract nouns in the objective, governed by the transitive verb 'could sustain.'

lyre—objective, governed by the prep. 'of.'
spark— " " " trans. verb, 'nursed.'
fire— " " " prep. 'of.'
injustice, fraud, and *wrong*—obj., governed by 'against.'

2. Give four examples, two of conjunctions joining co-ordinate (principal) sentences; two of conjunctions joining subordinate to principal sentences.

(1) Co-ordinate sentences.
(*a*) He confessed his fault, *and* was forgiven.
(*b*) I would assist you; *but,* alas! I have not the means.

(2) Subordinate sentences.
(*a*) He will be forgiven *if* he confess his fault.
(*b*) I cannot assist you, *because* I have not the means.

Geography.

Answer either Q. 2 or Q. 3; not both.

1. Draw a map of the coast-line from Dantzic to Bordeaux, marking river-mouths, capes, bays, and islands near the coast. Insert the lines of latitude and longitude.

2. Give notes of a lesson on this subject:—'*Our Colonial Possessions and their Value;*' showing which of them are useful to us for purposes of trade, which for emigration, and which for defence against foreign enemies.

NOTE.—*Lesson to be given before a map of the world.*

DEFINITION OF COLONY.—Colony is a foreign possession peopled by emigrants from a parent state. A British colony is peopled by settlers from Britain, which is called the mother country. Explain difference between 'emigrant' and 'colonist,' difference between a colony and a dependency. Australia is, properly speaking, a colony; India, a dependency.

POSITION OF THE COLONIES.—British colonies are not confined to any quarter of the world, but are scattered over all parts of its surface. In Europe are Heligoland, Gibraltar (the key of the Mediterranean), Malta, in the Mediterranean. In Asia are India, Ceylon, Hong Kong, Straits Settlements, Aden and Perim. In Africa are Cape Colony and others in the south, and Sierra Leone and others on the West Coast. St. Helena, Ascension, and Mauritius, off the coast. In America are Canada, British Columbia, and the most of the Leeward and Windward islands of the West Indies, with Jamaica, Bahamas, Trinidad, British Guiana, Honduras, and the Falkland Islands. Australia and New Zealand.

CHARACTER AND VALUE OF THE COLONIES.—Colonies indirectly confer great advantages on the mother country. One of the most valuable is that they furnish a new home for thousands of poor, who find it a hard struggle to live in their own country. Canada, Cape Colony, Australia, and New Zealand are especially adapted for this. Others are valuable as stations for sheltering our fleets, and consequently protect our commerce; such are Heligoland, Gibraltar, Malta, Mauritius. Others are trading stations, in which raw produce from the surrounding countries may be collected, or from which English goods may be distributed to them. Singapore and the settlements in West Africa are of this character. Others are useful as stations or half-way houses at which ships may call to take in water or provisions or coal; for example, Gibraltar, St. Helena, Mauritius, Aden, and the Falkland Islands.

3. Trace minutely (in words) the course of the St. Lawrence.

The St. Lawrence has its most remote sources in the western tributaries of Lake Superior and its entire length is estimated at 2150 miles. A large portion of its immense basin is occupied by magnificent freshwater lakes, the largest in the world. The river receives different names in the different parts of its course, as the St. Louis above L. Superior; the St. Mary between L. Superior and L. Huron; the St. Clair, between Lakes Huron and St. Clair; the Detroit, between Lakes St. Clair and Erie; the Niagara (famed for the Falls), between Lakes Erie and Ontario; the Iroquois, between Lake Erie and Montreal; and the St. Lawrence between that city and the Gulf of St. Lawrence.

SECOND PAPER.

Two hours and a half allowed.

History.

1. Trace the descent of Richard I. from William I., and as far as you can show the names and nationalities of Royal Consorts in the line.

William I. (the Conqueror) m. Matilda, of Flanders.
|
Henry I. (consort, Matilda of Scotland).
|
Matilda m. Geoffrey of Anjou.
|
Henry II. (Eleanor Countess of Anjou).
|
Richard I. (Berengaria of Navarre).

2. When and by whom was the first House of Commons called? Do you think that event of importance to the people?

In 1265, during the reign of Henry III., the first parliament was summoned by De Montfort, Earl of Leicester. This parliament is most memorable as including members who formed the original of the House of Commons. The knights of the shires and the representatives from cities and towns being elected by the people without doubt must be regarded as the beginning of the present Lower House, which is really the leading power in the state. The event is most important to the people because in voting money for the use of the Crown, the representatives of the people claim the right of calling on the sovereign to redress grievances.

3. What possessions had Henry VI. in France? How did he lose them?

Shortly after the death of Henry V., Charles VI. of France died, and his son, Charles VII., was crowned king of France at Poitiers, ruling south of the Loire, while *Henry VI.* was proclaimed King of France at Paris, his dominions being north of the Loire. The assumption of authority by Charles VII. was, of course, a direct violation of the treaty of Troyes. The English cause was ably maintained by Bedford, the ablest man of that age. The French were defeated by the Earl of Salisbury at Crevant, and by Bedford at Verneuil. In 1428 the English crossed the Loire and laid siege to Orleans. This famous siege lasted for seven months, and proved to be a great turning-point

in English and French history. The appearance of Joan of Arc soon caused the raising of the siege, and step by step did the heroic maid lead the French from victory to victory, until the coronation of Charles at Rheims. The events belong more especially to a history of Joan. The young king Henry was brought over to Rouen, 1430, and about a year and a half after was crowned at Paris. In 1435 the Duke of Burgundy concluded a peace with Charles and a few days after the great Duke of Bedford died. This event was the finishing blow to the dominion of England in France. By the marriage of Henry and Margaret of Anjou, the estates of Maine and Anjou were returned to her father. War continued until 1453 when not a foot of ground remained to England of all her continental possessions except Calais.

Composition.

Write full notes of a lesson on *Slate*.

Notes of a lesson on *Slate*.

I. WHAT IT IS.—When clay has been in a dry state for a very long time and has been pressed very much by other rocks, it can no longer be softened by water, and it can, when taken fresh from the quarry be split in thin flakes, or sheets by a chisel. It is called slate. Some time after being taken from the quarry, especially if the slate is acted on by frosts and thaws, it can no longer be split. Its colour is blue, grey, or greenish. (*Show pieces of roofing and other slates.*)

II. WHERE FOUND.—Slate is abundant in the mountains of North Wales, West of Argyle, Yorkshire, Westmoreland, Cornwall, Devonshire, in Spain and Italy, where pencil is made from it. The largest slate quarries of Wales are at Penrhyn and Llanberis, whence large quantities are exported to America and Australia. (*Places to be shown on map.*)

III. USES.—Slate is used for covering roofs, for cisterns, for mantle-pieces, headstones, whetstones, pencils. (*Show how adapted for these uses.*)

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Disobliging*.

Write, in small hand, as a specimen of copy-setting, *Bolingbroke was destined to be the sport of Fortune.*

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

1. From a given point P, to draw a straight line equal to a given straight line QR.

Prop. 2, Bk. I.

2. If the side MN of a triangle LMN be produced to R, the angle LNR shall be greater than the angle MLN.

Prop. 16, Bk. I.

3. If from the ends of a side of the triangle FGH there be drawn two straight lines to the point K within the triangle, these shall be less than the other two sides of the triangle, but shall contain a greater angle.

Prop. 21, Bk. I.

Needlework.

FEMALES.

One hour allowed for this Exercise.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after,* **1st *May,* 1878; and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the principal of which the simple interest for $3\frac{1}{2}$ yrs. at $2\frac{1}{2}$ per cent. will be £551 18s. $6\frac{3}{4}$d.

£2 10s. : £551 18s. $6\frac{3}{4}$d.
or or
2400 far. 529,851 far.
$3\frac{1}{2}$ yrs. : 1 yr. } :: £100 : principal.

$$\frac{£100 \times 529{,}851 \times 2}{2400 \times 7} = £7\tfrac{11}{14}\tfrac{22}{28} = £6307\ 15s.\ \text{Ans.}$$

2. A person loses at the rate of 10 per cent. by selling cloth at 15s. a yard. How ought it to have been sold to gain 20 per cent?

90 : 120 :: 15s. : required selling price.

$$\frac{15s. \times 120}{90} = 20s.\ \text{Ans.}$$

3. What will be the simple interest of 649 francs 75 centimes for 5 yrs. 4 months, at 3 centimes interest per annum for each franc lent? (100 centimes = 1 franc.)

$$\text{Interest} = 649{\cdot}75\text{ frs.} \times 5\tfrac{1}{3} \times {\cdot}03 = \frac{649{\cdot}75\text{ frs.} \times 16 \times 3}{3 \times 100}$$
$$= 103{\cdot}96\text{ frs.} = 103\text{ frs. }96\text{ cents.}\ \text{Ans.}$$

4. The population of a country is at present thirty-two millions; if it increases at the rate of 5 per cent. every year, what will it be at the end of 5 years?

This is equivalent to finding compound interest.

5 p.c. = $\frac{1}{20}$ of whole

32,000,000		
1,600,000		
33,600,000	population at end of 1st yr.	
1,680,000		
35,280,000	"	" 2nd "
1,764,000		
37,044,000	"	" 3rd "
1,852,200		
38,896,200	"	" 4th "
1,944,810		
40,841,010	"	" 5th " Ans.

FEMALES.

1. Find the simplest vulgar fractions equivalent to the decimals ·432, ·00625, ·1015625, ·0109375.

$$·432 = \frac{432}{1000} = \tfrac{54}{125}$$
$$·00625 = \frac{625}{100{,}000} = \tfrac{1}{160}$$
$$·1015625 = \frac{1015625}{10{,}000{,}000} = \tfrac{13}{128}$$
$$·0109375 = \frac{109375}{10{,}000{,}000} = \tfrac{7}{640}$$

2. Simplify 1·26 of $66\frac{2}{3} + 5\frac{1}{2}$ of 1·0375; and $3\frac{3}{4}$ of ·003 − ·0011 of $7\frac{1}{4}$.

(*a*) 1·26 of $66\frac{2}{3} = 1{\cdot}26 \times \frac{200}{3} = 84$

$+ 5\frac{1}{2}$ of 1·0375 $= \frac{26 \times 1{\cdot}0375}{5} = 5{\cdot}395$

$89{\cdot}395$ Ans.

(*b*) $3\frac{3}{4}$ of ·003 $= \frac{29 \times {\cdot}003}{8} = {\cdot}010875$

$- {\cdot}0011$ of $7\frac{1}{4} = \frac{{\cdot}0011 \times 29}{4} = {\cdot}007975$

$·0029$ Ans.

3. What is the value of ·07 of £2 10s. and of ·0474609375 of £10 13s. 4d.?

(*a*) ·07 of £2 10s. = 50s. × ·07 = 3·5s. = 3s. 6d. Ans.

(*b*) £10 13s. 4d. = 2560d. × ·0474609375 = 121·5d.
= 10s. $1\frac{1}{2}$d. Ans.

4. The price of ·0625lbs. of coffee being ·4583s., what is the cost of ·075 of a ton?

·0625 lbs = $\frac{1}{16}$ lb.
·075 ton. × 2240 = 168 lbs.
·4583 = $5\frac{1}{2}$d.

$\frac{1}{16}$: 168 :: $5\frac{1}{2}$d. : ?

$5\frac{1}{2}$d. × 168 × 16 = 14784d. = £61 12s. Ans.

Grammar.

1. 'There spent with toil he listless eyed
The course of Greta's playful tide;
Beneath her banks now eddying dun,
Now brightly gleaming to the sun.
Then tired to watch the current's play
He turned his weary eyes away,
To where the bank opposing showed
Its huge square cliffs through shaggy wood.'
—SCOTT.

(*a*.) Point out the enlargements of the subject which occur in the above.

(*b*.) Analyse the last three lines.

(*c*.) Point out and parse all the participles in the above.

(*a*) The enlargements of the subject are, (1) 'spent with toil,' (2) 'tired to watch the current's play.'

Analysis of (*a*)

(*b*)

Subject	'he'
Predicate	'turned'
Object	'eyes'
Enlargement of object	'his, weary,'
Extensions	(1) away, (2) 'to where,' . . . through shaggy wood,' *adv. clause of 'place.'*

Analysis of (*b*)

Subject	'the bank'
Enlargement of subject ...	'opposing'
Predicate	'showed'
Object	'cliffs'
Enlargements of object ...	'its,' 'huge,' 'square.'
Extension of predicate ...	'through shaggy wood' (manner.)

(*c*) *Spent*—irreg. intrans. verb, *spend, spent, spent*, complete part. qual. 'he'
eddying—reg. intrans. verb, incomplete part. qual. 'tide'
gleaming—reg. intrans. verb, incomplete part. qual. 'tide'
tired—reg. intrans. verb, incomplete part. qual. 'he'
opposing—reg. intrans. verb, incomplete part. qual. 'bank.'

2. Give examples of words compounded with the Latin prepositions *de, sub, trans*, and show what is the force of the preposition in each word.

de (down, away, from): *de*cay, *de*clare, *de*luct, *de*ject, *de*legate, *de*ny, *de*scend, *de*odorize.

sub (under, from, below, inferiority): *sub*altern, *suc*ceed, *suf*fix, *sug*gest, *sum*mon, *sup*plant, *sur*rogate, *sus*ceptible, *sou*venir, *so*journ. (The last two are French.)

trans (across, over, through, beyond): *trans*act, *tran*quil, *trans*cend, *tra*dition, *tres*pass, *tra*verse.

Geography.

1. Draw a full map of Turkey in Asia, including Palestine. Insert the lines of latitude and longitude.

2. Give notes of a lesson on 'Our Possessions in Africa;' *not* describing any one of them minutely, but giving the children clear ideas of their position, general character, and history.

OUR POSSESSIONS IN AFRICA.

METHOD.—Lesson to be given before a Map of Africa, or of the Eastern Hemisphere, or what is a better plan, outline map on black-board for places to be sketched as the lesson proceeds. Route from England, and distance to be shown clearly, by sketch and comparison. Children may have relations in some parts of Africa; elicit as much information as possible from the children, to get their own ideas of the Colonies.

POSSESSIONS.	POSITION.	GENERAL CHARACTER.	HISTORY.
I.—Cape Colony.	In south-western end of the Continent. Orange R. northern boundary, Indian Ocean on E., Atlantic on W., Antarctic on S.	Surface rises in three terraces from the coast to the interior. Flat district on coast. Little Karroo. Great Karroo. Climate warm and healthy. Deficient in rain. Flowers very brilliant.	The Cape discovered by Diaz, 1487. Colonized by Dutch, 1652. Taken by British, 1795. Restored to Dutch by Treaty of Amiens. Retaken 1806.
II.—Natal.	S.E. shores of Africa, between Drakenberg Mts. and the sea. 800 miles from the Cape.	Rises in three terraces, as in the Cape. Climate, resembles our own. Soil, various. Vegetables of all kinds abundant. Diamonds.	Discovered on Christmas Day, and called Natal, 1497. 1824 first British Settlement. Proclaimed a British Colony 1843.
III.—Griqua Land.	Between Cape Colony and the Transvaal.	Prevailing character is that of undulating plains, suitable for grazing. Diamond diggings.	Proclaimed British territory 1871. Diamond digging chief dependence of the inhabitants.
IV.—West African Settlements:—			
(*a*) Sierra Leone.	(*a*) In the basin of the Rokelle.	(*a*) Climate unhealthy. Fevers frequent.	(*a*) Colonized 1787.
(*b*) Gambia.	(*b*) At the mouth of the Gambia.	(*b*) Unhealthy. Exports various.	(*b*) Queen Elizabeth granted a patent to trade in 1591.
(*c*) Cape Coast Castle.	(*c*) Coast of Guinea.	(*c*) Unhealthy. Palm oil exported. Ground-nuts from Gambia.	(*c*) Portuguese settled this coast. English took it, 1661.
(*d*) Lagos.	(*d*) Near the Delta of the Niger.	(*d*) Same as (*c*.)	(*d*) Joined with Lagos 1824.

SECOND PAPER.

Two hours and a half allowed.

History.

1. What is meant by the Union of the Roses? How was this event brought about?

The Red and White Roses were the emblems adopted by the respective partisans of the houses of York and Lancaster, and worn by them in the long and sanguinary wars which desolated England during the reigns of Henry VI. and Edward IV., and were only terminated by the victory of the Lancastrian Henry Tudor, Earl of Richmond, at Bosworth Field, over Richard III. in 1485. The victor represented both houses, having married Elizabeth of York, daughter of Edward IV., and thus was brought about the Union of the Roses.

Who was Sir Thomas More? Give some account of his end.

Sir Thomas More succeeded Wolsey as Chancellor under Henry VIII., 1529. He continued to hold office till 1532, when, rather than favour the king's designs to procure a divorce from Catherine, and a marriage with Anne Boleyn, he retired from his Chancellorship. From this time Henry appears to have resolved upon the destruction of his old favourite. By a law, passed in the Session of 1533-34, it was made high treason to do anything to the prejudice of the king's lawful matrimony with Queen Anne; and it was provided that all persons should take an oath to maintain the whole contents of the statute. At the end of the Session Commissioners were appointed to administer the oath, and More was summoned before them to take it. More declined, was committed to the Tower, tried for high treason, and beheaded in 1535.

3. Mention some of our famous naval heroes, and give dates and particulars of Nelson's chief victories?

Among the naval heroes may be mentioned Drake, Blake, Monk, Dean, Penn, Jordan, Russell, Rodney, Howe, Jervis, Duncan, and Nelson.

In 1798, at the Battle of the Nile, the English (with fourteen ships) under Nelson, defeated the French (seventeen ships), under Admiral Brueys. Nine of the enemy's ships were captured.

In 1801 Lord Nelson bombarded Copenhagen. The whole Danish fleet was captured or destroyed, and the town compelled to surrender.

In 1805, off Trafalgar, the British fleet of twenty-seven sail and four frigates under Lord Nelson, engaged the French and Spanish under Admirals Villeneuve and Gravina (thirty-three sail and five frigates.) Nineteen of the enemy's ships were captured, but Nelson was killed in the hour of victory.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Disobliging*.

Write, in small hand, as a specimen of copy-setting, *Bolingbroke was destined to be the sport of Fortune.*

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including No. 2 (if possible).

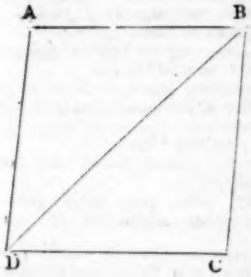
1. If a straight line QT, falling on two other straight lines PR, SV, make the alternate angles equal to one another, these two straight lines shall be parallel.

Prop. 29. Bk. I.

2. In what case will the diagonal bisect the angle of a parallelogram?

The diagonal will bisect the angle of a parallelogram when it has all its sides equal.

For let ABCD be a parallelogram having its four sides AB, BC, CD, DA equal to one another, and join DB; then DB shall bisect the angles ADC, ABC.



Because AB=AD, the angle ABD=the angle ADB (I. 5).

For the same reason the angle CDB=angle CBD.

But the angle ABD=the angle BDC. (I. 28.)

∴ the angle ABD=the angle CBD, that is, DB bisects ABC.

In the same way it may be shown that DB also bisects ADC.

Wherefore the diagonal bisects the angle of a parallelogram when all its sides are equal.—Q.E.D.

3. Let the sq. described on MN, one of the sides of △ MNR, = the sqs. on the other two sides of MR, RN.

Then shall ∠ MRN be a rt. ∠.

Prop. 48. Bk. I.

Algebra.

MALES.

Answer two Questions, including No. 2 (if possible).

1. Find the value of $\frac{x^4-y^4}{(x^2+y^2)^2}-\frac{x(x^2+xy+y^2)}{x^3-y^3}$ when $x=4$, $y=-3$.

$$\frac{256-81}{(16+9)^2}-\frac{4(16+4\times(-3)+9)}{64+27}=\frac{175}{625}-\frac{4\times13}{91}=$$
$$\frac{7}{25}-\frac{4}{7}=\frac{49}{175}-\frac{100}{175}=-\frac{51}{175}.\ \text{Ans.}$$

2. Prove the rule for finding the greatest common measure of two expressions.

Find it for $6a^3-6a^2y+2ay^2-2y^3$ and $12a^3-15ay+3y^2$; and hence reduce $\frac{12a^3-15ay+3y^2}{6a^3-6a^2y+2ay^2-2y}$ to lowest terms.

The proof of the rule for finding the G. C. M. depends on the following principles:

(*a*) If D divide A, then it will divide mA. For since D divides A, we may suppose A=aD, then mA = maD; thus D divides mA.

(*b*) If D divide A and B it will divide mA±nB. For since D divides A and B, we may suppose A=aD, and B = bD, then mA±nB=(mA±nB) D; thus D divides mA±nB.

Let A and B denote the two algebraical expressions, and let them be arranged according to descending powers of some common letter, and suppose the index of the highest power of that letter in A not less than the index of the same letter in B. Divide A by B: let p denote the quotient, and C the remainder. Divide B by C; let q denote the quotient and D the remainder. Divide C by D, and suppose that there is no remainder, and let r denote the quotient. Thus we have the following results:—

B) A (p
pB
C) B (q
qC
D) C (r
rD

A = pB+C; B = qC+D; C = rD.

Now, D divides C since C = rD; hence by principle (*a*) D also divides qC, and also qC+D; that is, D divides B. Again, since D divides B and C, it divides pB+C; that is, D divides A. Hence, since D divides A and B, it is a common measure of them. D is not only a common measure, but *the* greatest common measure.

By principle (*b*) given above, every expression which divides A and B divides A−pB, that is, C; thus every expression which is a measure of A and B is a measure of B and C. Similarly every expression which is a measure of B and C is a measure of C and D. Thus every expression which is a measure of A and B divides D. But no expression higher than D can divide D. Thus D is the G. C. M.

$12a^2-15ay+3y^2 \mid 6a^3-6a^2y+2ay^2-2y^3$ (2

$12a^3-12a^2y+4ay^2-4y^3$ ($a+y$

$12a^3-15a^2y+3ay^2$

$3a^2y+ay^2-4y^3$ (4

$12a^2y+4ay^2-16y^3$

$12a^2y-15ay^2+3y^3$

$19y^2 \mid 19ay^2-19y^3$ ($a-y$

$a-y$) $12a^2-15ay+3y^2$ ($12a-3y$

$12a^2-12ay$

$-3ay+3y^2$

$-3ay+3y^2$

∴ the G. C. M. is $a-y$. Ans.

And ∴ $\frac{12a^3-15ay+3y^2}{6a^3-6a^2y+2ay^2-2y^3}$ will be in its lowest terms if each term is divided by $a-y$, that is $\frac{12a-3y}{6a^2+2y^2}=\frac{3(4a-y)}{2(3a^2+y^2)}$

3. Solve the equations:—

(1) $\frac{3x+1}{2}-\frac{2x}{3}=10+\frac{x-1}{6}$

(2) $\frac{1}{x-1}-\frac{2}{x+7}=\frac{1}{7(x-1)}$

(1) Clearing of fractions, $9x+3-4x=60+x-1$

$9x-4x-x=60-1-3$

$4x=56$

$x=14$. Ans.

(2) Clearing of fractions, $7x+49-14x+14=x+7$

$7x-14x-x=7-49-14$

$8x=56$

$x=7$ Ans.

Needlework.

FEMALES.

One hour allowed for this Exercise.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after,* **1st May, 1878; and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Arithmetic.

MALES.

1. If a tax of 12 per cent. on the income of a country yields £5,200,000, how much will an income-tax of 5d. in the £ produce?

$\frac{12}{100} : \frac{5}{240} :: £5{,}200{,}000 : ?$

$$\frac{£5{,}200{,}000 \times 5 \times 100}{12 \times 240} = \underline{£902{,}777\ 15s.\ 6\tfrac{8}{9}d.}\ \text{Ans.}$$

2. A person's salary is £450 a year. He has £750 10s. stock in the 3 per cents., £500 railway debentures bearing 4½ per cent. interest, and £385 15s. India 5 per cent. stock. What does he pay a year for income tax at 5d. in the £?

		£
(*a*) £750·5 × $\frac{3}{100}$	=	22·515
(*b*) 500 × $\frac{4\frac{1}{2}}{100}$	=	22·5
(*c*) £385·75 × $\frac{5}{100}$	=	19·2875
Salary	=	450·
Total income	=	514·3025

(*d*) ∴ tax = 5d. × 514·3025 = 2571·5125d. = £10 14s. 3¼d.

3. A person buys coffee at £5 12s. 6d. per cwt. and chicory at £2 5s. 5d., and mixes them in the proportion of 2 of chicory to 5 of coffee. If he retails the mixture at 1s. 2½d. a pound, what is his gain per cent.?

	£	s.	d.
5 cwt. at £5 12s. 6d. =	28	2	6
2 ,, £2 5s. 5d. =	4	10	10
7 cwt. cost	32	13	4
∴ 1 ,, ,,	4	13	4
and 1 ,, is sold for 1s. 2½d. × 112 =	6	15	4
gain on 1 cwt. =	2	2	0

£4⅔ : £2⅛ :: 100 : gain p.c.

$$\frac{100 \times 21 \times 3}{10 \times 14} = \underline{45.}\ \text{Ans.}$$

4. Ten thousand pounds stock in the 3 per cents. is sold out at 92⅜, paying the usual brokerage; the whole is then reinvested in railway 6 per cent. £20 shares when they are at £5 premium clear. Find the alteration in income.

(*a*) Income from first investment = £10,000 × $\frac{3}{100}$ = £300

(*b*) By selling £10,000 it becomes £10,000 × $\frac{92{\cdot}25}{100}$ = £9225

(*c*) Income from railway shares = £9225 × $\frac{6}{100}$ = £442 16s.

∴ difference of income is £442 16s. − £300 or £142 16s. Ans.

FEMALES.

1. Required the amount of £825 13s. 8d. at 4¾ per cent. simple interest, in 3 years and 5 months.

$$\text{Interest} = £825\ 13s.\ 8d. \times \frac{4\frac{3}{4}}{100} \times 3\tfrac{5}{12}$$

$$= \frac{£13400\ 3s.\ 0\frac{7}{12}d.}{100}$$

	£	s.	d.
=	134	0	$0\frac{455}{1200}$
Add	825	13	8

∴ Amount = £959 13 $8\frac{455}{1200}$. Ans.

2. If two men A and B together can perform a piece of work in 10 days, and A by himself can do it in 18 days, what time will it take B to do it?

A and B can do $\frac{1}{10}$ in 1 day or $\frac{9}{90}$

A alone ,, $\frac{1}{18}$,, ,, $\frac{5}{90}$

∴ B alone ,, ,, ,, $\frac{4}{90}$

If B does $\frac{4}{90}$ in 1 day, then he will do the whole in $\frac{90}{4}$ days or $\underline{22\frac{1}{2}}$ days. Ans.

3. A person paid a tax of 10 per cent. upon his income; what must his income have been when, after he had paid the tax, there was £1,250 remaining?

After paying 10 per cent. he has $\frac{9}{10}$ remaining;

therefore his whole income = $\frac{£1{,}250 \times 10}{9}$ = £1388 17s. 9½d.

4. If 126 yards of cloth be bartered for 3 hhd. of brandy at 6s. 8d. per gallon, what is the price of the cloth per yd.?

126 yds. : 3 hhd. or 189 gals. :: 6s. 8d. : price of a yard.

$$\frac{6s.\ 8d. \times 189}{126} = \underline{3s.\ 4d. \times 3 = 10s.}\ \text{Ans.}$$

Grammar.

1. 'Every eye can *see* the beauty of the *remote*; but there is a beauty in the *near which* every eye cannot see. *Each* of the thousand little plants *that* spring *up* at *our* feet has an interest and beauty for the botanist; the mineralogist would *find* something to *engage* him in every little stone.'—WILSON.

(*a*) What kind of sentences are connected by adversative conjunctions? by relative pronouns? Illustrate your answer from the above, and give other examples.

(*b*) Parse the words in italics.

(*a*) (1) Co-ordinate principal sentences are connected by adversative conjunctions; as, 'Every eye can see the beauty of the remote,' *but* 'there is a beauty in the near which every eye cannot see.' 'I would assist you,' *but* 'I have not the means.' 'He tried frequently,' *but* 'he never succeeded.'

(2) Relative pronouns connect subordinate adjective sentences with the principal, qualifying some noun like a simple adjective; thus, 'which every eye cannot see' qualifies 'beauty'; 'that spring up at our feet' qualifies 'plants'; 'The man *who perseveres* generally succeeds,' 'who perseveres' qualifies 'man.'

(*b*) *See*—irreg. trans. verb, *see, saw, seen,* infin. pres., gov. by 'can.'

remote—adj. used as a noun, collective, neuter, plur., obj., gov. by 'of.'

near—same as 'remote,' collective, neuter, plur., obj., gov. by 'in.'

which—simple rel. pron., referring to 'beauty,' 3rd pers., sing. neut., obj., gov. by 'see.'

each—distrib. adj. pronoun, referring to ('*plant,*') 3rd pers. sing., neut., nom. to 'has.'

that—simple rel. pron., referring to 'plants,' 3rd pers., plur., neut. nom., subject of 'spring.'

up—adv. of manner modifying 'spring.' *Note.*—'Up' rather forms a part of the compound verb 'Up-spring.'

our—pronom. poss. adj., limiting 'feet.'

find—irreg. trans. verb, *find, found, found,* infin. pres., indef., gov. by 'would.'

engage—reg. trans. verb, infin., pres. indef., gov. by 'something,' or rather attributive to 'something.'

2. How comes it that there is a Latin, Celtic, and a Teutonic element in our language? Give examples of words belonging to each.

The language spoken by the Ancient Britons was Celtic, and many geographical and a few household names belong to this language, which is now represented by the Welsh and Gaelic; as, *Avon, Pen-maenmawr, Avran, Penrith, Auchinlech; mop, basket, bran.*

The Teutonic language comprises the Scandinavian dialect, and as men of Scandinavian race (Picts, Norsemen, and Danes) made repeated incursions into this island from the close of the eighth to the close of the tenth centuries, many words of Teutonic origin found their way into common use. The Scandinavian element in modern English includes geographical names; as, *Holbeck, Grimsby, Orkney, Dungeness, Skipton;* names of persons; as, *Anderson*; and words in common use; as, *braz, dairy, earl.*

The Romans occupied Britain for about four hundred years. The Latin introduced by the Romans themselves has been called *Latin of the First Period*; as, *Lancaster, Chester, Lincoln, Portsmouth, Wallbury.* The Latin brought in through intercourse with the Church of Rome is called *Latin of the Second Period*; as, *cloister, candle, saint.* The Latin that came to us through the Normans in the corrupt form of Norman French is called *Latin of the Third Period*; as, *armour, fa'con, charity, baron.*

The Latin that has been introduced by scholars since the revival of learning during the latter part of the fifteenth century is called *Latin of the Fourth Period.*

Geography.

1. Give notes of a lesson on 'The Eastern Coastline of the Atlantic Ocean.' Draw a map in illustration, and insert the lines of latitude and longitude.

'The Eastern Coastline of the Atlantic Ocean.'

METHOD.—Sketch on blackboard the various items as the lesson proceeds.

I. SHAPE AND EXTENT.—Eastern side nearly parallel with the western projections on one side, standing opposite indentations on the other—about 1,000 miles long—eastern coastline identical with the west coasts of Europe and Africa.

II. ISLANDS ALONG EAST COASTLINE.—East side of North Atlantic:—Great Britain and Ireland, Faroe Is., Channel Is., Canary, Madeira, and Cape Verd Is. Azores, and the islands in the Gulf of Guinea. The East side of South Atlantic has none of any importance.

III. BRANCHES ON THE EAST.—Baltic, North Sea, Irish Sea, English Channel, Bay of Biscay, Mediterranean, Gulf of Guinea.

IV. RIVER SYSTEMS.—East coast and its branches receive the principal rivers of the Old World:—Rhine, Loire, Tagus, Rhone, Po, Danube, and Don; Nile, Senegal, Niger, Congo, Orange.

2. Trace minutely (in words) the course of the Mississipi; describing the physical features of the country watered by it and its tributaries, and the chief towns in its basin.

The *Mississippi* rises in L. Itasca at an elevation of 3,000 feet. It receives the St. Peter's River, and continues south, receiving in succession the *Wisconsin*, *Iowa*, *Des Moines*, and *Illinois*, before it is joined by the *Missouri*, which, rising about the same parallel as the Mississipi, unites with its tributary the *Yellowstone*. The united stream flows S.E., through a fine open prairie, receiving the *Platte*, the *Kansas*, and the *Osage*. At the junction of the Missouri and Mississipi the streams are about half-a-mile wide, and, with the same width, the combined stream rushes on till joined by the *Ohio*, which rises in the Apalachian Mts., flows through a fertile and beautiful country, and has for branches the *Wabash*, *Cumberland*, and *Tennessee*. The main river, joined on the right bank by the *Arkansas*, flowing through a sandy district, flows on south to be augmented by the waters of the *Red River*, after which it enters the Gulf of Mexico. The area of its basin is estimated at a million and a quarter square miles. The principal towns are *Iowa*, *Jefferson*, *St. Louis*, *Pittsburg*, *Cincinnati*, *Natchez*, and *New Orleans*.

SECOND PAPER.

Two hours and a half allowed.

History.

1. Mention the European territories which have, at any time, belonged to England, and tell how we lost them?

By the Treaty of Troyes, concluded after the victories of Henry V., it was agreed that Henry should be Regent of France, and on the death of King Charles VI. succeed to the throne of that country. The Dauphin Charles refused to abide by the treaty, and Henry returned to fight him and his followers. During the campaign he died (1422), leaving Bedford, one of the cleverest men of his time, to maintain the cause of the young Henry VI. On the death of Charles VI. the Dauphin was crowned king, reigning over the country south of the Loire, while the part north of the Loire was held for Henry. Bedford in the first years of the war gained several victories, especially at Verneuil (1424.) But the victory was soon to be with the French.

Joan of Arc appeared on the scene, to inspire the French, and to lead them to victory. She succoured Orleans, then besieged by the English, and compelled the besiegers to retire (1429.) The 'Maid of Orleans,' as she was called, also defeated Talbot, one of the best of the English commanders; and Charles VII. was actually crowned at Rheims. In spite of the baseness of the English in burning Joan as a witch, their cause grew weaker and weaker, especially after the death of Bedford (1435); and at the end of the Hundred Years' War, England possessed not a spot of French territory except Calais, which was lost in the reign of Mary I. 1558.

2. What do you understand by the Declaration of Rights? Under what circumstances was it drawn up and signed?

In the Convention Parliament of 1689, the Prince of Orange refused the proposal of a regency; and, before filling the vacant throne, the Commons drew up, and the Lords accepted the 'Declaration of Rights,' which might be called the '*Magna Charta of the Revolution*,' only that its origin was above that of any royal charter, in the will of the people. It recapitulated the offences of the late king; reasserted the ancient rights of the people; settled the crown first on William and Mary, as king and queen; next on the survivor of them; then on the queen's issue; failing them, on the Princess Anne, and her issue; and lastly, failing them, on the issue of the Prince of Orange.

3. When was the Quebec Act passed? Explain its main provisions, and show their effect upon Canada during the war of American Independence.

The Quebec Act was passed 1774. By this Act, the Roman Catholic religion was set free from legal disability, and reinstated in its right to exact tithes and other dues from all persons who owned its sway; French civil law was reimposed, but the Criminal Code of England was set up instead of that of France; and the province was to be ruled by a Government and Council appointed by the Crown, one-third of the Council being composed of French Canadians.

It inflicted many evils on the Colony, but it served well the immediate purpose for which it was intended. It satisfied the old settlers, and held them firmly to the side of England during the wars which England vainly waged against the American Colonies.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word, *Disobliging.*

Write, in small hand, as a specimen of copy-setting, *Bolingbroke was destined to be the sport of Fortune.*

Composition.

Write a short essay on *Courts of Justice.*

Courts of Justice are of various kinds, according to the various constitutional systems of different countries. Some may have limited jurisdiction, both as to place and as to the kind of matters which they can hear and determine. Some have no limit to their jurisdiction, except the limits that the government itself has—namely, its territory. From those Courts that have a limited jurisdiction, there may be an appeal to those Courts which have not a limited jurisdiction; and accordingly, some Courts may be called inferior, and others superior, or other terms may be used to express this relation.

In England and Ireland the superior courts of common law are the Queen's Bench, Exchequer, and Common Pleas. The law which is called equity, is administered in the Court of Chancery.

From each of the three superior courts of common law in England and Ireland, there is an appeal to the Court of Exchequer Chamber; and a further appeal to the House of Lords, which is the Supreme Court of Appeal.

In Ireland the Court of Quarter Sessions is similar to the English County Court, the Chairman of which is a barrister-at-law, who has exclusive jurisdiction in civil cases, and presides with the Justices of the Peace in criminal cases.

In Scotland the Supreme Civil Court is the Court of Session. It consists of an Inner and an Outer House, and has thirteen judges attached to it. An appeal in matters of law is given to the House of Lords. The High Court of Justiciary is the highest Criminal Court. There is a Sheriff Court in every county.

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including Q. 2 if possible.

1. Let APZ be a right-angled △, having the rt. ∠ APZ Then the sq. on AZ=the sqs. on AP, PZ.

Prop. 47, Bk I.

2. If the sides of a triangle be as 2, 4, 5, is it acute or obtuse angled? (Prop. 12, Bk. II.)

If the sides of a triangle be as 2, 4, 5, it is an obtuse-angled triangle, for the square described on the side which is 5 is greater than the sum of the squares on the other two sides; that is 25 is greater than 4+16 or 20. For the angle opposite the greater side cannot be a right angle, since the squares on 5 would then be equal to the sum of the squares on the other side, by I. 47; and the angle cannot be acute, since the square described on the first side would then be less than the sum of the squares described on the other sides, by II. 13; therefore the angle must be obtuse.

3. To divide a given straight line HK into two parts at L, so that the rectangle contained by HK, LK, may be equal to the square on HL.

Prop. 11, Bk. II.

Algebra.

MALES.

Answer two questions, including Q. 2, if possible.

1. If two fractions are together equal to 1, show that their difference is the same as the difference of their squares.

Let $\frac{x}{y}$ be one fraction, then $1-\frac{x}{y}$ or $\frac{y-x}{y}$ = the other

By hypothesis $\frac{x}{y}\infty\frac{y-x}{y}=\left(\frac{x}{y}\right)^2\infty\left(\frac{y-x}{y}\right)^2$

First let $\frac{x}{y}$ be the greater, then $\frac{2x-y}{y}=\frac{x^2}{y^2}-\frac{y^2-2xy+x^2}{y^2}$

$$,, \quad =\frac{x^2-y^2+2xy-x^2}{y^2}$$

$$,, \quad =\frac{2xy-y^2}{y^2}$$

$$,, \quad =\frac{2x-y}{y}$$

In a similar manner it may be shown that $\frac{y-2x}{y}$ is equal to the difference of the squares when $\frac{y-x}{y}$ is the greater.

2. Obtain a general rule for the extraction of square root, by observing in what manner a and b may be derived from $a^2+2ab+b^2$.

Extract the square root of $1+x$ to three terms.

Since the square root of $a^2+2ab+b^2$ is $a+b$, a general rule for the extraction of the square root may be obtained by observing in what manner a and b may be derived from $a^2+2ab+b^2$.

$$\begin{array}{l} a^2+2ab+b^2(a+b \\ \underline{a^2} \\ 2a+b)2ab+b^2 \\ \quad \underline{2ab+b^2} \end{array}$$

Arrange the terms according to the dimensions of one letter a, then the first term is a^2, and its square root is a, which is the first term of the required root. Subtract its square, that is a^2, from the whole expression, and bring down the remainder $2ab+b^2$. Divide $2ab$ by $2a$ and the quotient is b, which is the other term of the required root. Multiply the sum of twice the first term and the second term, that is $2a+b$ by b, the second term, and subtract the product, that is $2ab+b^2$, from the remainder. This finishes the operation in this instance. If there were more terms we should proceed with $a+b$ as we did formerly with a; its square has already been subtracted from the proposed expression, so we should divide the remainder by the double of $a+b$ for a new term in the root, and then for a new subtrahend we should multiply this term by the sum of twice the former terms and this term. This process must be continued till the root is found.

$$\begin{array}{l} 1+x\left(1+\frac{x}{2}-\frac{x}{8}\right. \text{ Ans.} \\ \underline{1} \\ 2+\frac{x}{2}\Big|\,x \\ \quad \underline{x+\frac{x^2}{4}} \\ 2+x-\frac{x}{8}\Big|\,-\frac{x}{4} \\ \quad \underline{-\frac{x}{4}-\frac{x^2}{8}+\frac{x^3}{64}} \end{array}$$

3. Solve the equations:—

$$\left.\begin{array}{l} (1)\ ax+by=c \\ \quad\ mx+ny=r \end{array}\right\}$$

$$(2)\ x=5+\frac{6000}{x}$$

(1) $ax+by=c$ or $amx+bmy=mc$ (multiplying by m)
$mx+ny=r$ or $amx+any=ar$ (,, ,, a)

Subtracting $bmy-any=mc-ar$

$$y=\frac{mc-ar}{bm-an}\text{ Ans.}$$

In a similar manner $x=\frac{nc-br}{an-bm}$ Ans.

(2) $$x=5+\frac{6000}{x}$$

Clearing away fr. $x^2=5x+6000$

Transposing $x^2-5x=6000$

Completing square $x^2-5x+\frac{25}{4}=\frac{24000+25}{4}=\frac{24025}{4}$

Taking root $x-\frac{5}{2}=\pm\frac{155}{2}$

$x=\frac{5}{2}\pm\frac{155}{2}=$ 80 or -75. Ans.

Mensuration.

MALES.

The sides of a triangle are 11, 24, and 31; show that its area is $66\sqrt{3}$.

$\frac{11+24+31}{2}=33$, half the sum of the sides.

$\therefore$ Area $=\sqrt{33\times(33-11)\times(33-24)\times(33-31)}$

$=\sqrt{33\times22\times9\times2}$

$=\sqrt{13068}$

$=\sqrt{4356}\times\sqrt{3}$

$=66\sqrt{3}$.—Q.E.D.

Needlework.

FEMALES.

One hour allowed for this Exercise.

Messrs. Isbister and Co. have sent us copies of the first three volumes of their new Natural History Reading Books, by the Rev. J. G. Wood. For reasons which will at once suggest themselves to our readers, we are unable to examine these books critically in the usual column. We must therefore content ourselves by congratulating the Messrs. Isbister upon having secured the services of Mr. Wood, and by saying that, taken altogether, they are the *best* Natural History Reading Books we have seen.

***

We have received (just as we go to press) an advance copy of the first number of that periodical whose issue has been looked forward to with so much interest by the literary world—*Longman's Magazine*. We have neither space nor time for detailed criticism, and must therefore content ourselves by saying it appears to us a *marvellous* sixpennyworth. The following authors contribute to it—James Payn, John Tyndall, F.R.S., W. D. Howells, the Author of 'John Halifax, Gentleman,' Richard Owen, R. L. Stevenson, E. A. Freeman, and F. Anstey.

ANSWERS TO ARITHMETICAL QUESTIONS IN 'THE SCHOLAR,' FOR NOVEMBER, 1882.

STANDARD IV.

A. 1. £431 9s. 3¾d.
2. £20,471 10s. 8d.
3. £651 14s. 3½d.—7.
B. 1. 194,292 lb.
2. £88 18s. 2½d.—75.
3. £185,228 3s. 11½d.
C. 1. 20,880 min.
2. 2s. 4½d.—4471.
3. 172 ton, 7 cwt., 3 qrs., 3 lb. 5 oz.
D. 1. £29 13s. 9d.
2. 115,706¼ sq. ft.
3. £734 4s. 11¾d.
E. 1. £3 5s. 3¾d.—16,935.
2. £182 16s. 3d.
3. 174 c. yd. 26 ft. 1280 in.
F. 1. 25 ton, 0 cwt. 3 qr. 22 lb.
2. 9,652,260 sec.
3. £759 17s. 8¼d.

ADVANCED EXAMINATION.

1. 274,239 sq. in.
2. 60s. and 20 h. cr.
3. 1,456,677 min.

STANDARD V.

A. 1. £52 10s. 10½d.
2. £148 5s. 11¾d.
3. 75
B. 1. £4,249 10s. 4¾d.
2. 14s. 7d.
3. £2,892 3s. 4d.
C. 1. 40
2. £7,561 2s. 7½d.
3. £8 10s. 4½d.
D. 1. £26,154 4s. 3d.
2. £16 4s. 5$\frac{11}{16}$d.
3. 119 books.
E. 1. £169,306 8s. 1½d.
2. £8,352 16s. 3¾d.
3. 5 to 3.
F. 1. £29 10s. 4d.
2. £136,849 18s. 8¼d.
3. £79 19s. 1¾d.

ADVANCED EXAMINATION.

1. M. £2 10s., w. 16s. 8d., b. 8s. 4d.
2. £33 11s. 8¼d.
3. £486 5s. 7½d.

STANDARD VI.

A. 1. 2¾.
2. $\frac{1}{2}$.
3. $\frac{8}{15}$.
B. 1. ·635.
2. 1900.
3. 10·08 lbs.
C. 1. 66⅔ miles.
2. 14 to 13 tr. to p.
3. 3s. 4$\frac{11}{13}$d.
D. 1. ·0006125.
2. $\frac{15}{17}$.
3. £14 17s. 2$\frac{2}{5}$d.
E. 1. 2·6622 ton.
2. 15 ac. 3 r. 25 p. 13$\frac{3}{4}$ sq. yd.
3. ·000852+.
F. 1. $\frac{15\frac{1}{2}\frac{1}{4}}{18\frac{1}{4}}$.
2. ·31522.
3. £366 13s. 4d.

ADVANCED EXAMINATION.

1. 6$\frac{1}{2}$$\frac{1}{2}$ days.
2. 6½ days.
3. £1,078 2s. 6d.

STANDARD VII.

A. 1. £17 1s. 3d.
2. £481 9s. 9$\frac{3}{4}$d.
3. £2 14s. 2d. per cent.
B. 1. 2$\frac{1}{4}$$\frac{1}{2}$ per cent.
2. 4$\frac{6}{13}$ per cent.
3. £357 2s. 10$\frac{7}{9}$d.
C. 1. 2$\frac{1}{4}$$\frac{1}{2}$ years.
2. 79$\frac{3}{4}$$\frac{3}{8}$ per cent.
3. 26$\frac{1}{11}$$\frac{6}{11}$ per cent.
D. 1. £1 2s. 6$\frac{8}{11}$$\frac{8}{11}$d.
2. £78 14s. 1$\frac{6}{11}$$\frac{6}{11}$d. P.W.
3. 1s. 1½d. each knife.
E. 1. £9 17s. 0$\frac{3}{8}$d.
2. £2,125.
3. £20,015.
F. 1. 1$\frac{1}{8}$$\frac{8}{9}$ average.
2. 2$\frac{1}{2}$$\frac{1}{2}$ per cent.
3. 2$\frac{7}{19}$d.

ADVANCED EXAMINATION.

1. 6½ per cent.
2. £892 5s.
3. 7s. 4$\frac{1}{4}$$\frac{1}{1}$.

SOLUTIONS OF THE 'ADVANCED EXAMINATION' QUESTIONS IN 'THE SCHOLAR,' FOR NOVEMBER, 1882.

STANDARD IV.

1. 26 sq. yd. 7 ft. 120 in. = 34,824 sq. in. in small class-room.
34,824 × 1½ = 43,530 ,, large ,,
78,354 × 2½ = 195,885 ,, main room.
274,239 sq. in. Ans.

2. 3s. + 2s. 6d. = 5s. 6d.; £5 10s. ÷ 5s. 6d. = 20 h. cr. Ans.
And 20 × 3 = 60 shillings. Ans.

3. From July 2nd, at 6.48 a.m. = d. h. m.
182 17 12 rem. of 1879.
366 0 0 year 1880 (leap yr.)
365 0 0 ,, 1881.
97 20 45 part of 1882.
Ans. 1,456,677 min. = 1011 13 57

STANDARD V.

1. 48 women = 16 men, and 60 boys = 10 men, making a total equivalent of (40 + 16 + 10 =) 66 men. Then £165 ÷ 66 = £2 10s. a man's share, ½ of £2 10s. = 16s. 8d. a woman's, and ½ of 16s. 8d. = 8s. 4d. a boy's share. Ans.

2.

	s. d.		£ s. d.
48 lb. at	0 1¾	an oz. =	5 12 0
1½ cwt. ,,	0 8½	a lb. =	5 19 0
2½ ton ,,	7 6	a cwt. =	16 17 6
480 tins ,,	5 9	a doz. =	11 10 0
80 ,, ,,	0 7½	each =	2 10 0
		Total	42 8 6
		Less 2½d. in the 1s. =	8 16 9½
			£33 11 8¾ Ans.

3. 52 lb. × 532 = 27,664 lb. = 247 cwt.
247 at £1 19s. 4½d. = £486 5s. 7½d. Ans.

STANDARD VI.

1. 1 coat and 1 vest = 1½ coats; 32 hr. ÷ 1½ = 24 hrs. in which A makes a coat. 1 c. + 2 v. = 1¾ coats; 36 hr. ÷ 1¾ = $\frac{1440}{70}$ = 21$\frac{30}{70}$ hrs. in which B makes a coat. $\frac{1}{24} + \frac{1}{21\frac{3}{7}} = \frac{1}{11\frac{9}{70}}$ fraction of a coat made by both in one hour. 4 c. + 5 v. = 5¼ coats; and (5¼ + $\frac{1}{11\frac{9}{70}}$ ÷ 10) = ($\frac{17}{3}$ × $\frac{849}{1079}$ × $\frac{1}{10}$) = 6$\frac{1}{11}$$\frac{1}{9}$ days. Ans.

2. Taking the work done by a man in an hour as the *unit*, we have,—10 × 15 × 40 = 6,000 units to be done, and (9 × 12 × 20 =) 2160 + (10½ × 8 × 30 =) 2520 = 4680 units done by first two sets of men. Then 6000 − 4680 = 1320 units yet to be done; 12 × 18 = 216 units done in one day; hence 1320 ÷ 216 = 6$\frac{1}{9}$ days. Ans.

3. £12,500 × ·425 = £5312 10s. 1st payment.
£12,500 − £5312·5 = £7187·5 the rem. after the above.
£7187·5 × ·85 = £6109 7s. 6d. 2nd payment.
£12,500 − (£5312 10s. + £6109 7s. 6d. =) £1078 2s. 6d. Ans.

STANDARD VII.

1. The working expenses being 60 per cent., the net earnings must be 40 per cent. = (£1,731,250 × 40) ÷ 100 = £692,500. Debenture interest = $\frac{1}{16}$ of £2,000,000 = £80,000; preference interest = (£2,500,000 × 4½) ÷ 100 = £112,500. Then £692,500 − (£80,000 + £112,500) = £500,000 dividend on the (£12,500,000 − £4,500,000 =) 8 million ordinary stock. Hence £500,000 ÷ 80,000 (the number of hundreds) = 6¼ per cent. Ans.

2. As the P. W. if invested will yield as much interest as has been deducted for discount, £860 × $\frac{1}{16}$ × $\frac{3}{4}$ = £32 5s. the discount that has been taken off, hence £860 + £32 5s. = £892 5s. Ans.

3. £250 + (20 p.c. of £250 =) £50 = £300 total selling price. £125 + (35 p.c. of £125 =) £43·75 = £168·75 received for half the cloth; £250 ÷ 5 = £50, cost of the fifth; 15 p.c. (£7 10s.) from which = £42 10s. received for the fifth or 160 yds. £300 − (£168·75 + £42 10s.) = £88 15s. selling price of the remaining (800 − 560 =) 240 yards, which gives 7s. 4$\frac{2}{3}$d. a yard. Ans.

THE COBBLER.

Moderato marcato. *mf* T. CRAMPTON.

1st TREBLE.
2nd TREBLE.

1. Tap, tap, tap! goes the cob - bler on his last, Tap, tap, tap! strikes his
2. Tap, tap, tap! with - out ceas - ing, ham - mers he; Tap, tap, tap! till his
3. Tap, tap, tap! thus he earns his dai - ly bread; Tap, tap, tap! thus his

BASS.

KEY C. *Moderato marcato.* *mf*

2nd TREBLE. | d' .s :d' .t ,l | s ,l .s .f :m | m' .d' :r' .d' ,t |
1st TREBLE. | m .m :m .f .f | m .f .m .r :d | s .s :t .l .s |
BASS. | d .d :d .d .d | d .d .d .t, :d | d .m :s .fe .s |

ham - mer, fall - ing fast; Tap, tap, tap! from the morn - ing's ear - ly light,
arm must wea - ry be; Tap, tap, tap! hap - py with his hum - ble lot,
chil - dren dear are fed. Tap, tap, tap! this the thought his arm that nerves,—

l ,t .d' ,r' :t	r' .s :m' .r' .d'	r' .d' .t .d' :r'
fe .s .l .fe :s	s .s :s .s .s	t .l .s .l :t
r .r .r .r :s	t, .t :d' .m .m	s .s .s .s :s

Tap, tap, tap! till the dark - 'ning shades of night. Tap, tap, tap, tap,
Tap, tap, tap! on he works and mur - murs not. Tap, tap, tap, tap,
Tap, tap, tap! that he works for those he loves. Tap, tap, tap, tap,

m' .m' :r' .d' .t	l .t .d' .r' :s	d' .s :d' .s
s .s :s .fe .s	fe .s .l .fe :s	m .m :m .m
d .d' :t .l .s	r .r .r .r :s	d' . :d' .

tap, tap, tap! Tap, tap, tap, tap, tap, tap!
tap, tap, tap! Tap, tap, tap, tap, tap, tap!
tap, tap, tap! Tap, tap, tap, tap, tap, tap!

l .d' :s .	m' .d' :l .	t .r' :d'
f .f :m .	s .s :f .	r .f :m
f .l :d' .	d .m :f .	s .s :d

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Publications Reviewed.

Lectures on Teaching. By J. G. Fitch, M.A. London: Cambridge University Press.

We have received from the Cambridge University Press Warehouse this new and cheaper edition of Mr. Fitch's 'Lectures on Teaching.' When the book was first issued it was fully noticed in our columns. We need now only add, that in our opinion, it is a work so excellent that every teacher should study it.

The Dictionary of Education and Instruction. New York: E. Steiger and Co.

This is an admirable 'reference' volume, worthy of our warmest praise, and which we wish we could see on the shelves of every pupil-teacher's library in the kingdom. Its chief aim is to supply a brief compendium of the theory and practice of education in a series of clear and definite articles, alphabetically arranged so as to be easily referred to, or systematically studied; to encourage in this way the study by teachers of the principles and practice of their profession, thus giving to the work of education a greater degree of intelligence and efficiency; and to afford a convenient class manual of pedagogy for use in normal schools and teachers' institutes as the basis of a course of instruction in principles and methods, not necessarily superseding other valuable manuals differently arranged, but accompanying and strengthening them. The articles are from the pens of the best writers, both on this and the other side of the water.

Halfpenny Maps. London and Belfast: Marcus Ward and Co.

For want of a better title we thus refer to a series of excellent maps clearly printed in colours and highly finished. Those before us comprise *Europe*, *India*, *Germany*, *Canada*, *Oceania*, *Australia*, *New Zealand*, and *Central America*. Doubtless, England and other portions of the British Isles will be added, if not already forming part of the series, and also France, Italy, Spain, Turkey, Norway and Sweden, and Russia. But from the examples before us, nothing more can be desired in the way of a correct, clear, and beautiful map on a small quarto scale. The printing, or rather engraving, is very clear and distinct, and the colouring most carefully finished.

The Simple Outline of English History. For Standard IV. London: Cassell, Petter, and Galpin.

This book answers to its title of being an outline of English History, and in this displays considerable skill in the way of condensation and arrangement. The outline is also drawn with remarkable evenness of style and general freedom and fairness. But the introductory part has the usual commonplace errors about the Britons, who, according to the compiler, were 'naked savages' when invaded by the Romans. The Saxons, we are told, 'were cruel and bloodthirsty in their fighting, and when they won a battle they slew all their enemies who fell into their hands, except a few whom they kept to be their slaves.' Now, the *theowes* or *servi* among the Anglo-Saxons were persons taken in war and criminals irrespective of race. No competent historian identifies them with the Ancient Britons. Even these *theowes* were not hopelessly shut up in perpetual bondage. But the Britons were to be found largely among the classes of freemen and even Thanes. 'As a race, the Britons were not merely allowed to continue on the conquered territory, but tempted to do so by various advantages.'* They continued to reside in towns of their own, though in many cases these towns were subjugated by the Teutonic tribes. In these towns the Britons continued to live under laws and magistrates of their own and within the bounds, too, of the victors' jurisdiction, as was the case with the *Wealas* of Wessex (at Exeter) until the time of Athelstan's extension of the West Saxon dominions. Doubtless, many British captives taken in battle were put in the rank of *servi*, but only as Saxons, Angles, or Danes were also put under similar circumstances. Unless taken as prisoners of war or convicted of great crimes, the Britons generally belonged to the different classes of

* Dr. Nicholas.

ceorls. Doubtless, also, much, though certainly not all, of the land was taken from the Britons by the successful Angles and Saxons. In the laws of King Ina, compiled at the close of the 7th century, we have the Wealas proprietors of various degrees, and chargeable with *wergild* on a 'hide' of land or more. Further, it is provided that the Wyliscman who should possess five 'hides' of land should enjoy the rank of Thane, the same qualification for the Saxon's advance. Many other proofs might be adduced to show that the Britons and Saxons were on the whole treated alike, and that the servile or exterminatory theory is unsupported by anything like proof. The printing of this book of *Outlines* is clear and good, and the illustrations ample and appropriate. Among them is the upper part of the figure of Henry VIII. from the fine portrait at Petworth. Altogether the book is most readable and free from masses of dates and names, which in such a compendium would be quite out of place. The maps are clear, good, and instructive.

Cassell's Book of Sports and Pastimes. London: Cassell and Co.

This is a capital interesting serial, whose contents are aptly described in the title.

Friar Hildebrand's Cross; or, the Monk of Tavystoke Abbaye. By M. A. Paull. Hodder and Stoughton.

This is a fairly well-written story, in the way of a fragmentary autobiographical record concerning a sixteenth-century monk, who had quite mistaken his vocation, which therefore became a *cross* to him. For Hildebrand is not only inclined in a distinctly sensuous, albeit innocent, way to all the intellectual pleasures of this life, as painting, and music, and flowers, and scenery, and so forth, but also he falls violently in love with one Cicely, his own scholar, a very charming Queen of the May, who, however, honestly marries a handsome young miller, and has as her firstborn a namesake Hildebrand, as her second a Cicely: all which are manifestly nails in the cross of our stricken and yet pious friar. The end of the story is that Martin Luther's Reformation comes on about that time, and King Harry destroys the monastery, dispersing its inmates, after their 600 years of monkery, and our now semi-Protestant friar emigrates to Compoella in Mexico, dying some years after in the arms of his young namesake who accompanied him. The story is of good humane interest, as illustrative of a heart almost literally crucified by a compelled celibacy, that old normal tyranny of the monastic system.

The volume (well printed and tastefully bound) is swelled into a larger bulk than the biography, by some so-called MSS. 'found' in a chest of 'ye Abbaye' by our monk, detailing sundry not very interesting historical events from time to time, in an imitated archaic phraseology, which consists chiefly in the transmutation of the letter i into y, and in adding an e at 'ye ende ofe manye a worde,' which does not deceive the modern reader nor improve the antique style. An extract or two from the book may serve to illustrate our fair criticism, as thus: Hildebrand's Romish idolatry is shown in the carved image he has made of St. Cecilia, which he avouches (p. 335) to be that of Cicely herself—'Cannot Cicely trace her own fair image in that lovely form? will she never guess of all my tenderness, my faith, my sacrifices, my cross? alas, never!'

His sensuous love of Nature is frequently shown, as thus: 'What glory and beauty exist in men alone; what infinite pleasure I have experienced many a time in the rich carmine, and amber, and azure, and emerald hues with which I illuminate; I have rendered a devout thanksgiving upon bended knees for the tints of a sunset,' etc., etc. . . . . Again: 'We monks, who shut out the common passions of humanity from the heart, do not therefore necessarily become pure; but, alas! very often give only the more place to the gluttony, the avarice, the pride, the superstitions, that are abhorrent to our Master Christ.'

On the whole, the author, or authoress, is to be commended for a wholesome and interesting story which, it is to be hoped, will find a welcome among many readers.

The History of a Lump of Coal. By Alexander Watt. London: A. Johnston, Paternoster Buildings.

We opened this book with interest from having read with pleasure other scientific brochures by Mr. Watt. On the whole we are not disappointed, though we fail to follow Mr. Watt in attributing the formation of coal to the Noachian Deluge. Mr. Watt supposes 'that while this terrible effect of Divine wrath was being consummated, countless millions of trees' . . . . were uprooted, floated on the waters, became deposited in the valleys on the subsidence of the waters, and 'in process of time' would undergo those slow changes so as to become converted into beds of petrified or fossilized organic matter, which we now call coal. Though we have condensed, we have not misrepresented Mr. Watt, and leave geologists to smile at this novel way of accounting for the coal formation, which lies far beneath the Tertiary strata, and for the top of which, the alluvial beds of clay and Bagshot sands, they require a period of several millions of years!

Leaving—as it had better be left—this fanciful dragging in of the Biblical Deluge, we proceed on safer ground to question Mr. Watt's fears for the not very distant exhaustion of our coal beds. Certainly the consumption is enormous, notwithstanding a great strike or two now and then, but we have lately had satisfactory assurances of the probable existence of fields upon fields, which may lessen anxiety for some 50,000 years at least.

Mr. Watt traces the history of gas and other products of coal interestingly and succinctly. Gas, we learn, after being successfully used by Mr. Murdoch in his house at Redruth was used in public at Birmingham on the occasion of the National Illumination for the Peace of Amiens in 1802. In less than twenty years after this its adoption was general. William Murdoch has, however, as Mr. Watt remarks, been almost forgotten.

The discovery, however, of the wondrous wealth of colouring matter in the once despised and worthless coal-tar forms as may be supposed the most interesting portion of Mr. Watt's book. The brilliant colours of which mauve and magenta had the first run have almost revolutionized the art of dyeing, by acting on the fabrics directly and without the intermediate process of 'mordanting,' or dyeing with a preliminary colour. The preparation of the intense and brilliant colours, of which the aniline group is the principal, Mr. Watt well describes, and believes there are yet more discoveries to be made in addition to those by which immense fortunes have been obtained.

Altogether Mr. Watt has given us a most readable collection of the information connected with our 'black diamonds.'

Blackie's Sixth Geographical Reader. By W. G. Baker. London: Blackie and Sons.

This book, taking up Asia, Africa, and America, is certain to take a leading position among the most useful of school books. It differs favourably from most geographies, which, however meritorious as compilations, seldom contain a touch of lively description or animated colouring. The book before us, while giving all needful facts and figures, comprises attractive and readable sketches of people, scenery, and other features that make up the best books of travels. In addition to these lively and always appropriate selections, Messrs. Blackie have given a series of physical maps of unusual excellence. By skilful and artistic touches the engraver gives us a clear picture by way of a map of mountain valley, river,

and plain. From these maps alone clear notions of physical features are obtained at a glance. Further, we have a liberal supply of other illustrations, all appropriate and helping much to ensure the retention of the knowledge conveyed by the letterpress. In China, for example, we have a capital picture of a 'Tea Plantation,' in which the natives are gathering the leaves from the small shrubs, while being overlooked by a fan-bearing proprietor. Beyond is a river on which junks are sailing, and in the distance a pagoda. In the descriptive sketches Colonel Burnaby is largely quoted, and the best writers on several other countries. A summary is appended, in which a vast number of facts are epitomized in about half-a-dozen pages. The book is worthy of the highest praise.

General Biology. By E. B. Aveling, D.Sc. London: Stonecutter Street.

This work is stated to be specially adapted for the Elementary Examination in General Biology of the Science and Art Department, South Kensington. We cannot think, however, that the author has been happy in his attempt at producing a text-book for this Examination. The book presents a large mass of information, much beyond the requirements of Elementary Biology; and this information is presented in an extremely condensed form, reminding one of lecture-notes requiring further elaboration and explanation.

The whole treatment of the subject is suitable rather to the requirements of the advanced student and teacher, than of the boy beginning the study of science. The technical words used are generally explained, and their derivation given; but occasionally we meet, with difficult words unexplained: such as 'homology,' 'analogy,' 'excrementitious.'

We would specially recommend the book to the favourable notice of those studying Biology for the intermediate B.Sc. examination. It would also be useful to teachers requiring an accurate and complete *resumé* of the Science Department syllabus.

To be of use for young pupils, however, it will require much simplification, and, what is more important still, the addition of illustrations.

It is true that the methods of observing the *things themselves* are here described; but pupils too commonly do not know what they are to see, and whether they see the right thing, unless some illustration is given to guide them.

The book is clearly printed, and on the whole singularly free from printers' and other errors.

On page 81 we note that chara and the fern are described as flowering plants. Doubtless this is an accidental mistake.

On page 12 degrees of temperature are mentioned without stating what scale is used; as the centigrade scale is mentioned on page 18, we presume this is intended throughout.

In a book intended for young students, it would have been better to mention the English equivalents of millimetres, though we quite agree as to the desirability of stating all measurements in the metric system.

The author's tendency to introduce debateable matter is on the whole kept well in the background, though it creeps out occasionally. Thus we have a comparison instituted between the Bronnian movements in inorganic particles suspended in water, and the oscillatory movements in the 'still-stage' of Bacteria.

A 'cell' is defined on page 35 (after considerable use of the name without a definition) as 'a mass of protoplasm surrounded by a definite wall, and enclosing a more solid portion known as nucleus.'

The term 'plastid' is used to imply a mass of protoplasm without an enveloping cell; and 'cytod,' a mass of protoplasm enveloped by a distinct wall, without a nucleus Such a limitation of the meaning of 'cell' is extremely unsatisfactory, especially as it obliges us to banish the term from Animal Physiology, and so creates confusion in our terminology. Prantl and Thomé do not recognise such a definition of cell, but regard the presence of protoplasm as the only necessary element; the presence of nucleus and cell wall, or their absence, constituting important varieties of cell.

The description of each organism is placed under fixed divisions, which are valuable as ensuring a systematic study.

In the description of Bacteria we have the following:—'(*d*) Circulation.—In this connection nothing is to be said.' This very ambiguous statement evidently assumes the acquaintance of the student with the fact that Bacteria have no circulatory apparatus, an assumption which no good elementary teacher would make.

We are told that if a white corpuscle is carefully watched under the microscope, it will be observed to undergo slow alterations of form. This statement, unaccompanied as it is by any further explanation, would certainly lead to disappointment on the part of a student who thus watched a corpuscle. The fact that a warm stage is required (temp. of 50°C.) ought to be insisted on, as well as that even then the movements are extremely slow and difficult to trace.

There are some very useful tables throughout the book, as of the differences between a fern and a flowering plant, the classification of vegetabilia, etc.

At the end of the book is a useful glossary.

Animal Physiology. By A. Willis. Adapted to the Requirements of the Education Code. Stage I. R. J. Derfel, Manchester.

We are sorry to have nothing good to say concerning this pamphlet-like book. A first glance through it shows that it bristles everywhere with technical words, and these are used to such a superfluous extent that we are bound to say, that if we wished children to imbibe a dislike for the study of physiology, the first step we should take would be to place this book in their hands.

These technical terms are much more numerous than the requirements of an elementary text-book necessitate. What need, for instance, to talk of 'sarcolemma,' 'orbicular ligaments,' 'gastrocnemius and soleus muscles,' 'foramen magnum,' etc., etc., in a book intended for boys and girls of a tender age? Surely none of her Majesty's inspectors could require a knowledge of such words as these! So anxious is the author to give everything a technical name, and so impressed is he with the importance of not calling a spade a spade, that even ribs are dignified with the name of 'costæ.' Surely this is going too far! In Gray's 'Anatomy,' the standard work for medical students and others who have to study the structure of the body in great detail, 'costæ' are not so much as mentioned.

Looking through this book more carefully, we find it not only bristling with technicalities, but full of inaccuracies and misstatements. Here are a few specimens.

On the first page the ligaments are described as being *elastic fibres*. This is true of one or two sets of ligaments, as the *ligamenta subflava* of the spinal column, where they are elastic for a special object. But in all other cases the ligaments are pliable but almost perfectly inextensible; so much so that the fibres in cases of injury will rather rupture than stretch. If it were not so, dislocations would be much more frequent than they now are.

There is a full figure of a skeleton on the second page. We would recommend the right knee to the notice of the artist. The joint is considerably deformed, and looks as if the subject depicted had suffered from rheumatism for many years.

The side view of the skull on the next page is extremely sketchy and inaccurate. The frontal bone sticks out in the shape of a knob that would delight phrenologists, but is certainly not normally present; on the malar bone is another knob which does not exist except in the imagination of the artist; while the sigmoid notch of the lower jaw is much too shallow.

'But it is quite accurate enough for children,' will be said. We have no sympathy with such a slovenly excuse for inaccuracy. Children who see these illustrations will imagine that they represent the truth, and thus false teaching will be imparted, very difficult to eradicate.

Resuming our invidious task of pointing out errors—in the next illustration, figuring the thorax, we find the sternum carefully divided into six segments by transverse lines. In the adult condition there are only three segments, the fœtal six segments having become fused.

We learn for the first time, as is stated a little further on, that there are nine *false vertebræ*. It is true that the sacrum and coccyx are composed of nine fused vertebræ, but to call them false vertebræ (unless on the ground that they are generally known by this name) is useless.

The pelvis is said to be composed of the two *ossa innominata*; as a matter of fact, it consists of these two bones *plus* the sacrum and coccyx. Three of the false ribs are stated to be joined together at their ends, and then to the sternum by a band of cartilage. This is incorrect. They are joined on to the seventh rib which articulates (some distance away) with the sternum.

The *trunk* is said to be composed of vertebræ, ribs, sternum, scapulæ and clavicles. The two last do not belong to the trunk, but to the upper extremity. The leg is said to consist of femur, tibia, etc., the os innominatum being omitted. Where, then, shall we put this bone? does it belong neither to the trunk *nor* to the leg?

The tibia, we are told, 'received its name from the resemblance it has to a musical instrument (Lat. tibia=flute).' The author has only got hold of half the truth here, the resemblance between the triangular tibia and a flute is surely very remote! The real origin of the name lies in the fact that flutes were formerly made out of *hollow* bones, like the tibia.

The tarsal bones are *laterally* articulated with each other, we are told. This expresses just half the truth. Too much detail ought not to be given in an elementary book, but what is given ought to be accurate. The omission of the word 'laterally' would have made the sentence true, and not half true.

The list of inaccuracies in the description of bones is not exhausted, but let us turn to the muscles. They are described as consisting of a number of fibres, connected together in bundles, and these bundles enclosed in sheaths of *sarcolemma*. This is grievously incorrect. The sheath binding the muscle-bundles together is generally called 'perimysium,' but it is a word we should be sorry to use in teaching children. Sarcolemma is the sheath of each individual fibre, not of the bundles of fibres, and much less binding these bundles together.

Turn to the skin. It consists of an outer layer or cuticle, and an inner layer or cutis. Immediately below the outer layer, we are told, are the pigment cells. This is grossly inaccurate. The pigment cells are in the *rete mucosum*, or deeper part of the outer layer.

We will not attempt to describe the section of skin depicted. It makes one's hair 'stand on end,' by a mechanism that is not accurately drawn in the diagram.

The diaphragm is described as a *flat* muscular partition.

The thorax is said to contain the organs of circulation and respiration; and the abdomen, the organs of alimentation and excretion. Now the organs of excretion are the lungs, the skin, and the kidneys. As the lungs are in the thorax, and the skin, *not* in the abdomen, the inaccuracy o such a classification is obvious. The description of the abdominal organs would surely confuse and mislead a most intelligent boy. The size of the liver is not given; and the pancreas is stated to be a *large* oblong gland. The natural inference would be that the pancreas is larger than the liver.

The kidneys are stated to be the only organs in the abdomen outside the peritoneum. As a matter of fact there are *no organs inside* the peritoneum, which is a closed sac; but if the author means that the kidneys are the only organs not *surrounded* by peritoneum, he is again inaccurate. Part of the rectum and duodenum, part of the bladder, and the suprarenal bodies, are uncovered by peritoneum.

The function of the pancreas is stated to be to digest starch and fat, and no mention is made of the infinitely more important action on proteids.

Such are a few of the mistakes to be found within the small compass of this book. We leave teachers to decide whether it is a reliable handbook in the study of the science which it professes to teach.

The New Code, with Explanatory Notes and a Copious Index. By T. E. Heller. London: Bemrose and Sons.

To praise this book (which, by the way, includes the 'Instructions to Inspectors,' and other official forms and documents), compiled by Mr. Heller, would be a work of supererogation. No man living is better fitted to annotate the Code than the Secretary of the National Union of Elementary Teachers, who, we scarcely need add, has done his work conscientiously and well.

The Children's World. By E. M. M. London: A. Johnston.

This pleasant lecture was arranged for the author's children and little friends, and by request has been printed for the benefit of those who may wish for their children an easy method of enabling them to remember many common facts relating to the world. It is short interesting, and instructive.

Johnston's General Knowledge Charts. Compiled by W. Stephen. W. and A. K. Johnston, Edinburgh.

This is a well-arranged and useful series of charts, four in number, mounted on roller, ready to be hung on the walls of any schoolroom. We think they will prove acceptable to many teachers, as they contain just what is wanted for school work. Sheet No. 1 deals with Great Scientific Discoveries, and those who have been mainly instrumental in investigating them. No. 2 contains a list of the most celebrated British Historians and the chief points of interest connected with them and their works. Sheet 3 is devoted to Distinguished Inventors, their Inventions, and the main incidents of their lives: and Sheet 4 contains a chronologically arranged list of our best known Poets, their leading dates, and chief works. Clearness of printing and arrangement is not one of the least valuable features of the series.

The First Six Books of the Elements of Euclid, with Copious Annotations and Numerous Exercises. By J. Casey, LL.D., F.R.S. Dublin: Hodges, Figgis, and Co.

The preface states that this book 'is intended to supply a want much felt by teachers at the present day—the production of a work which, while giving the unrivalled original in all its integrity, would also contain the modern conceptions and developments of the portion of geometry over which the elements extend.'

The book is all and more than all it professes to be. It forms a capital introduction to the modern methods of geometry.

The propositions suggested are such as will be found to have most important applications, and the methods of proof are both simple and elegant. We know no book which within so moderate a compass puts the student in possession of such valuable results.

Perhaps the exercises left for solution are somewhat difficult, but they are all such as will repay patient study, and those whose solutions are given in the book itself will suggest the methods by which the others are to be demonstrated.

We recommend every one who wants good exercises in geometry to get the book and study it for themselves.

The book is well printed in large and clear type; the figures are well drawn, and the general get-up of the book leaves nothing to be desired.

Longmans' Modern Copy-Books. London: Longmans and Co. No. VII. Double Small Hand; VIII. Double Small and Text; IX. Double Small (Narrative). X. Small Hand. XI. Small Hand—Invoices, Business Forms, etc. XII. Correspondence, etc.

Provision is made in the first three of the above books for the work of Standard III., and the remaining numbers are designed for the upper standards. We presume these capital writing-books were planned prior to the issue of the newest of new codes, as in Standard III. there are neither exercises in large hand nor figures, both of which are prescribed in the document which will hereafter be associated with Mr. Mundella's name. Of the character of the writing, however, we cannot speak too highly. Perhaps the best praise we can give it is to say that it is just what the Education Department asks for. In the selection of the subject-matter, and in the general arrangement of these books, sound judgment has been shown. Messrs. Longmans' modern copy-books can fairly claim to rank amongst the best in the market.

Longmans' Modern Arithmetics. Standards V., VI., and VII. Answers to Standards I.-VII. London: Longmans and Co.

We advise teachers who contemplate a change of arithmetics when their inspection is over to examine this new series before making a final choice. They will find here numerous graduated examples, accompanied by short, clear, and comprehensive explanations of rules, etc. To the children who of necessity attend school irregularly, and have to pursue their studies at home, these explanations will prove invaluable. Candidates and young pupil-teachers who work through the higher books will find themselves all the better equipped when their annual examination comes round.

White's Grammar-School Texts. (1) Xenophon's Anabasis. Lib. VII. Longmans.

Schoolboys in this happy nineteenth century may well thank Dr. White for the easy ladders whereby they can climb the hill of knowledge: both in this instance and in the notice immediately following, the road to Parnassus is cleared of rocks and is strewed with roses. One of the books of Xenophon's famous 'Cyric Travel' is here beautifully printed, with a glossary of every word fully expounded in English, etymologically and grammatically. How different from the old day when our Schrevelius explained hard Greek in harder Latin, and several big volumes had to be examined, for the knowledge now contained in one small handbook bound up with the text.

(2) Virgil's Æneid. Lib. XI. Longmans.

Parents and teachers, as well as their children and scholars, can equally bear out the justice of our remarks above. There is absolutely nothing to be desired in the way of *practical teaching* which such manuals as these do not efficiently supply. Virgil, as well as the old Greek historian above mentioned, is here made easy to the English schoolboy, whilst instead of heavy and expensive crown octavos, one little 16mo gives all the literature necessary at minimum cost.

The Fifth Illustrated Reader. Longmans' Modern Series. London: Longmans and Co.

This book is well fitted to take a leading place among School Readers. It is varied, interesting, and calculated to invite youthful readers to acquire more fully knowledge in the paths it opens. While Milton, Shakspere, Scott, and other great writers are not forgotten, we have extracts from newspapers, magazines, and other modern sources selected with judgment and good taste. Not the least attractive to boys will be the capital cricketing lines, entitled, 'Nat Ricket.' A charming prose sketch, 'The Story of the Year,' is from the ever-pleasing pen of Hans Andersen. The book is also excellently printed and suitably illustrated.

Selected Plays from Shakspere. By S. Brandram. London: Smith, Elder, and Co.

We congratulate Messrs. Smith, Elder, and Co. upon the timely issue of the following neatly-bound, abridged plays:—'The Merchant of Venice,' 'Romeo and Juliet,' 'A Midsummer Night's Dream,' 'Much Ado about Nothing,' 'Twelfth-Night,' 'As You Like It,' 'Hamlet,' 'Macbeth,' and 'The Tempest.' They have been compressed and adapted for school use by Mr. Brandram, so well known to the world as a successful Shaksperian reciter. Teachers in our public elementary schools would certainly have set more value upon the books as school-readers if a few simple explanatory notes had been appended. We heartily commend Mr. Brandram's plays.

Essay on Lord Clive. By Lord Macaulay, with Introduction and Notes by G. B. Turnbull, M.A. London and Edinburgh: W. and R. Chambers.

We have pleasure in recommending this little edition of one of Macaulay's most interesting essays, and congratulate Mr. G. B. Turnbull on the manner in which he has compiled the notes. They are concise, thorough, and satisfactory in every respect.

Chaucer: 'The Squiere's Tale,' with Life, Grammar, Notes, and an Etymological Glossary. London and Edinburgh: W. and R. Chambers.

This little book is complete in itself, and its possession will enable the student to thoroughly study this work of Chaucer's without the trouble of referring to other text-books. From the Life of Chaucer at the commencement to the Glossary at the end, all the contents are thoroughly satisfactory.

Shakspere's 'King Henry V.' London and Edinburgh: W. and R. Chambers.

It is a pleasure to meet with this book. The notes, to which additional clearness is given by change of type, are clear and concise, exactly fitted for school use, and the Examination Questions at the end will prove valuable to students and teachers alike.

Facts to Impress, and Fancies to Delight. London: Partridge.

A pretty little gift book for the young, comprising five short biographies, five historical notices of castles and abbeys, and eight simple stories, each of the eighteen subjects being illustrated with suitable woodcuts, all being neatly printed and tastily bound, and quite a bargain at one shilling and sixpence. As to any critical remark, of course there must be much of omission in such scant sketches of famous men; and in the story department it is a pity to have named a dissolute (though finally repentant) young man Walter Raleigh. Such a misnomer—for he might just as well have been styled John Smith—confuses biography in the young mind in tale-telling as much as geography is confounded in America by, for example, the New York State propinquity of Ithaca, Syracuse, Batavia, and Buffalo. But perhaps this is hypercritical, and it need not affect our kindly commendation of Mr. Frederic Gammon's little book.

Our Little Ones. London: Griffith and Farran.

This superbly illustrated magazine maintains its general excellence. We are glad to see that Mr. Crampton, he veteran song writer, is now on the staff.

The Children's Daily Help for the Christian Year. London: Griffith and Farran.

This little book will, we think, prove welcome in many families, for the printing being clear and the type large, it is suited to young learners, and the texts and verses have been selected with evident care and skill.

What Her Majesty's Inspectors Say. By T. R. Clifford. Darlington: North of England School Furnishing Co.

This excellent digest of the Blue-Book makes its appearance for the third time, and we accord it a hearty welcome. Mr. Clifford has taken exceptional pains to render his work trustworthy and useful, and in this he has thoroughly succeeded. Every one interested in education should possess a copy.

Christmas and New Year Cards. London: Hildesheimer and Faulkner.

The struggle between manufacturers seems to be becoming more intense every day. At least that is the only way in which we can account for the perfection of the specimens before us. As examples of lithographic skill they can hardly be excelled, and we have great pleasure in recommending them to the notice of our readers. Some of the larger cards are 'gems' in delicacy of colouring and in elegance of design, and one wonders how so much science and skill in art can be expended on so cheap an article with any degree of profit.

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Science Notes.

A NEW FORM OF THERMOMETER.—M. Michelson has brought before the French Physical Society a new form of thermometer, for which he claims so extraordinary a sensitiveness that he hopes by it to measure intervals of temperature of not more than one-thousandth of a degree centigrade. The principle of the bimetallic thermometers is the basis on which the instrument is constructed, but instead of two metals being used, M. Michelson adopts ebonite and platinum. Ebonite is more than ten times more dilatable than platinum, and a spring composed of the latter on one side, and the former on the other, will curve with the slightest addition of heat. At the extremity of the spring, instead of a pointer working along a scale, is fixed a glass stem, which touches a mirror suspended by a single fibre of unspun silk. By every change in the curvature of the spring, the mirror is moved, and a ray of light reflected from its surface moves up and down the divisions of a scale.

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THE LATE PRESIDENT GARFIELD.—Even after the lapse of what in the present rapidly moving age is a considerable interval of time, the subject of President Garfield's untimely fate always excites a melancholy interest. The celebrated surgeon, Professor Essnarch, has lately published a lecture which he delivered some months ago before the Physiological Society of Kiel, on the treatment of the wound. He maintains that it was not necessarily mortal, and that the injured vertebra could have been healed. Death resulted, he thinks, from the way in which the antiseptic treatment was applied, together with the mistake of searching for the bullet. He argues that the example of Von Langenbeck, in the case of the German Emperor, should have been followed, and the bullet allowed to remain. Had this been done, and the antiseptic treatment rigorously applied, he maintains that a fatal issue would have been avoided.

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SCIENTIFIC CHEESE-MAKING.—The inquiry has often been made why the different sorts of cheese we have vary so greatly in flavour. Those made in different districts have marked characteristics that distinguish them sharply from each other, although they may all be made in precisely the same manner. On the other hand, the different sorts, so readily recognisable by the palate, may be made in very different ways. The distinction between different kinds seems therefore to be local, and to depend upon circumstances other than the process of manufacture. This idea is borne out by some very interesting experiments made by a French chemist, Mons. E. Duclaux, who set himself to discover the causes which determine the flavour of cheese, and the causes of its variation. His researches tend to prove that neither climate, soil, food, manipulation, nor variety in the breed of the cows, largely affects the quality of the flavour, but that the secret of the differences must be looked for in a lowly organism. A fungus or mould is communicated by germs in the atmosphere to the cheese in the course of its manufacture, and with the nature of the ferment so supplied the taste of the mature cheese is associated. The fungus he found to vary in different cases, in some being allied to the yeast plant, in others to the common mould.

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EXTINCTION OF FIRE.—Many have been the efforts of chemists and engineers to produce some means for the rapid extinction of a conflagration that shall be speedy, certain, and of such a nature as not to cause almost as much damage to goods as the enemy it seeks to quell. It is well known that in the case of many fires as much loss is caused by the water poured into the seat of the evil as from the direct action of the flames. We have had, hence, machines patented supplying water in small quantity, but that water charged with a large volume of carbonic acid, the effect of which has been rapid and certain. Now another claims attention, and puts its powers forward to bid for our support. This is an engine known as 'Vinning's Patent,' and it delivers water highly charged with compressed air. Recently a public trial was held upon a vacant piece of ground at the City end of the Thames Embankment, which resulted in a successful demonstration of the fact that a fiercely burning fire can

be as effectually and speedily suppressed with plain water thrown at a high pressure as with water charged with carbonic acid or other chemical agents which have hitherto been employed. The engine is made of wrought copper, and as no chemicals nor acids of any kind are required, the inventor claims that it is entirely free from the rust and corrosion which make all chemical engines such short-lived appliances. The chief difficulty which has proved fatal hitherto to the success of the compressed-air extinguishers is their liability to leak under the long-standing pressure exerted over the whole of the apparatus. This difficulty the inventor claims to have overcome by an arrangement through which the air pressure is brought to bear upon the water only when the engine is to be used. It can be charged in five minutes by means of the air-pump, up to a pressure of 100 lb. to 140 lb. per square inch. In the experiment tried, the material was purposely of the most inflammable description possible, being composed of shavings and straw, enclosed in roughly built shanties or frameworks of wood, and the whole saturated with paraffin. The flames made havoc at once with these, but the effect of the charged water was to rapidly check and very soon entirely extinguish them.

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A NEW ICE-MAKING MACHINE.—The transition from the consideration of fire to that of ice is natural and easy, but while the *extinction* of the one is a desideratum, the *production* of the other is the point of interest. The Aylesbury Dairy Company have recently brought before the public some elaborate machinery for this purpose, which was recently tried with considerable success on their premises at Bayswater. It is known as the 'Patent Vacuum Pump Refrigerator,' and it is claimed on its behalf that it excels any existing machinery in maintaining a vacuum for manufacturing and chemical purpurposes, for cooling water on a large scale, and for making ice of great purity and lasting character. It is said that in hot climates the machine will have a distinct advantage over its rivals, as it may be worked there effectually and economically. With regard to the mode of action, it should be borne in mind that in a vacuum below five millimetres of absolute pressure water evaporates to the extent of about one-sixth of its quantity, and by the process of evaporation robs the other five-sixths of so much heat as to turn it into ice. The nearer the rarefaction in the freezing chamber employed approaches to the point of an absolute vacuum, the quicker is the evaporation, and the greater the cold under which the ice forms. In the engine used, the air-pump establishes a vacuum in the cylinders in which the water is to be frozen. The water is then conducted into these cylinders, the air contained in the liquid is set free, and forms with the vapour from the one-sixth of the water a mixture, which, to preserve the necessary vacuum, must be rapidly removed. The mixture before reaching the pump passes over concentrated pure sulphuric acid in a cylinder where the moisture is absorbed by the acid, and the air-pump has only a little dry air to remove. The remaining quantity of water left in the cylinders is turned into ice, and when a sufficient quantity is obtained, say 6 cwt. in one cylinder, the blocks are allowed to fall by their own weight into a cellar or other receptacle below, by the mere unscrewing of the hinged floor of the cylinder, and the admission of air. The whole work of the production and discharge of the ice is performed by the apparatus, and for a machine which produces 12 tons of ice in twenty-four hours, the services of only one man at a time are required. The machine consequently involves a much cheaper production than any other machine in use. The item of steam power required to make the ice is also less than in other engines, only about 1½ lbs. of coal being used in the manufacture of a ton of ice. The machine has been already successfully used in the cooling of water for breweries and chemical factories, and in the manufacture of soap, candles, and chocolate.

* * * * *

THE CENTENARY OF BALLOONING.—From a book called the 'History of the Academy of Sciences' for 1783 it appears that the first trial of the invention of the balloon by the elder Montgolfier was made at Avignon in the course of the month of November, 1782. The French Academy of Meteorological Aerostation has decided to celebrate the hundredth anniversary of this event by a public banquet. It is interesting to compare with the monster vehicles now in use the description of Montgolfier's balloon. It was constructed of silk, was in the shape of a parallelopiped, and had a capacity of only forty cubic feet. It was inflated with air, and ascending power was given to it by heating its contents by means of a fire of paper suspended beneath its opening.

* * * * *

MARSH FEVER AND SULPHUR.—A French chemist, Mons. d'Abbadie, has made a communication to the Academy of Sciences in Paris, in which he draws attention to the efficacy of sulphur in preventing the propagation of marsh fever. It has been observed by travellers, he says, that the elephant hunters in Ethiopia are not affected by the most unwholesome air, and that they are in the habit of fumigating their bodies daily with sulphur. Professor Sylvestri, of Catania, in Sicily, a district famous for its sulphur mines, stated in answer to questions from Mons. d'Abbadie that intermittent fever was never fatal in that locality. Moreover, in the surrounding villages 90 per

cent. of the population were attacked by the fever, but in the sulphur-producing villages the proportion was only from 8 to 9 per cent.

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RECENT BOTANICAL WORK.—The past year has been very noteworthy from the many important investigations that have been made by the leading German botanists into the intimate constitution of vegetable organized structures. Lately researches have been published which lead for the first time to a satisfactory explanation of the processes of the thickening that take place in the walls of cells, and which clear up the hitherto confused questions of the appearances known as striation and stratification. The formation of starch also in the cells of the plant has received further elucidation, and the little masses of protoplasm or amyloplasts, which were last year discovered to be the centres of origination of starch formation in the parts of plants not exposed to light, have been ascertained to differ only in respect of colouring matter from the chlorophyll corpuscles which form the starch in the leaves under the action of light. Finally, further investigation as to the part played by the chlorophyll in this starch formation and in the decomposition of carbonic anhydride proves all the theories yet advanced as to its mode of action to be erroneous, and to show that this is a question that must engage the attention of scientific workers for some time yet to come.

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MYSTERIOUS RELICS IN THE SOUTH PACIFIC.—The following interesting account is from the *Leisure Hour*:—"The island of Rapa Nui owes its interest to its mysterious relics of a forgotten race, who have utterly and completely died out even from legendary lore, while their handiwork abides, written on the rocks, which are so covered with carving as to resemble the studio of some giant sculptor. Colossal stone images lie half buried beneath the creeping grass and encroaching scrub. They are all hewn of a close-grained grey lava, which is only found at Otouli, a crater on the east side of the island. On a platform near this quarry several gigantic images stand in perfect preservation. One of these measures twenty feet from the shoulder to the crown of the head. They represent an unknown type. Very square face—short, thin upper lip, giving a somewhat scornful expression—broad nose, and ears with pendant lobes. All the faces look upward. The eyes are deeply sunken, and are supposed to have originally had eyeballs of obsidian. The statues are literally lying about in hundreds, and the very rocks on the sea beach are carved into strange forms—tortoises or human faces."

Publications Received.

Animal Physiology

(1) Willis's Animal Physiology. Stage I. R. J. Derfel.

Biology—

(1) Dr. Aveling's General Biology. 28, Stonecutter St., E.C.

Book-keeping—

(1) Sheriff's Single Entry. Allen and Co.
(2) Sheriff's Double Entry. Allen and Co.
(3) Sheriff's Single Entry shown by Double Entry. Allen and Co.

Charts—

(1) Johnston's General Knowledge Charts. Nos. 1, 2, 3, 4. W. and A. K. Johnston.

Christmas Cards—

(1) Hildesheimer and Faulkner.

Classics—

(1) White's Grammar School Texts. Virgil's Æneid. Book XI. Longmans and Co.
(2) White's Grammar School Texts. Xenophon. Book VIII. Longmans and Co.

Electricity—

(1) Ferguson's Electricity. W. and R. Chambers.

Euclid—

(1) Casey's First Six Books. Longmans and Co.

Geography—

(1) Blackie's Geographical Reader. No. 6. Blackie.
(2) The Children's World. Part 1. A. Johnston.

History—

(1) Simple Outline of English History. Cassell, Petter, and Galpin.

Maps—

(1) Marcus Ward's Series of Halfpenny Maps. Marcus Ward and Co.

New Code—

(1) The New Code, with Explanatory Notes by T. E. Heller. Bemrose and Sons.

Miscellaneous—

(1) Watts' History of a Lump of Coal. A. Johnston.
(2) Paull's 'Friar Hildebrand's Cross.' Hodder and Stoughton.
(3) Clifford's 'What H. M. Inspectors Say.' North of England Scholastic Trading Co., Darlington.
(4) The Children's Daily Help for the Christian Year. Griffith and Farran.
(5) Macaulay's Essay on Lord Clive. W. and R. Chambers.

Periodical Literature—

(1) Cambridge Examiner. Vol. 2. No. 7. Stanford.
(2) Universal Instructor. Part 24. Ward, Lock, and Co.
(3) Sports and Pastimes. Part 7. Cassell, Petter, and Galpin.
(4) School Examiner. Gage and Co., Toronto.

Poetry—

(1) Shakspere's 'Romeo and Juliet,' 'Hamlet,' Much Ado about Nothing,' 'The Tempest,' 'The Merchant of Venice,' 'A Midsummer Night's Dream,' 'Macbeth.' Smith, Elder, and Co.
(2) Shakspere's 'King Henry V.' W. and R. Chambers.
(3) Chaucer: 'The Squiere's Tale.' W. and R. Chambers.

Readers—

(1) The Rev. J. G. Wood's Natural History Readers. Standards 1, 2, 3. Isbister.
(2) Chambers' Historical Readers. Part 3. W. and R. Chambers.

Teaching—

(1) Fitch's Lectures on Teaching. Cambridge University Press Warehouse.

Query Column.

☞ **As the answer to a single question often entails an expense six or seven times greater than the cost of the complete key to any of the Arithmetics or Algebras ordinarily used, the Proprietor of this Journal would be glad if students confined themselves to questions, the full working of which is not published in the form of a 'key.'**

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. Replies will not be sent through the post.

4. Correspondents are requested to write *legibly*, and on one side of the paper only.

5. Correspondents wishing us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, must, in all cases, send a copy of Regulations up to date.

6. Queries must reach the office *not later than the 15th of the month*, or they cannot be attended to in the ollowing issue.

7. All queries in future must have a pseudonym, and must be written on a slip of paper other than that which bears the real name and address of the sender.

*** All communications for this column should be addressed

'*The Query Editor*,'
The Practical Teacher,
Pilgrim Street, Ludgate Hill,
London, E.C.

Arithmetic.

1. INQUISITIVE.—(*a*) A beats B by 10 yards in 100 yards race, and B beats C by 10 yards in 100 yards race. Required by how many yards A will beat C in 1000 yards race.

(*b*) Also if A starts at the rate of $3\frac{1}{2}$ miles an hour, and B follows him 4 hours after at the rate of 4 miles an hour, how many miles has A travelled before B overtakes him?

(*Edinburgh University Local Examination*, 1882.)

(*a*) A runs 100 yards while B runs 90 yards,
B " " " C " "
∴ A runs 100 yards while C runs $\frac{90 \times 90}{100}$ yards
$= 81$ yards;
∴ A will beat C by $(100 - 81)$ yards × 10 or 190 yards in 1000 yards race. Ans.

(*b*) Distance gone by A in 4 hours $= (3\frac{1}{2} \times 4)$ miles
$= 14$ miles;
" gained by B in an hour $= \frac{1}{4}$ mile;
∴ Time to gain 14 miles $= 28$ hours;
∴ Distance gone $= (28 \times 4)$ miles
$= \underline{112 \text{ miles}}$. Ans.

2. PLUTO.—Two persons start from London and Brighton (50 miles apart) at the same time; the first goes $4\frac{1}{2}$ miles an hour, and rests 20 minutes at the end of every 10 miles; the other walks steadily $3\frac{1}{2}$ miles an hour. Where will they meet?

They would meet $\left(50 \times \frac{4\frac{1}{2}}{4\frac{1}{2} \times 3\frac{1}{2}}\right)$ miles or $28\frac{4}{7}$ miles from London, if the first person did not rest;

But he rests 40 minutes, and therefore is $\frac{2}{3}$ of $4\frac{1}{2}$ miles or 3 miles from this place;

Part of this distance gone by second person when they meet
$= 3 \times \left(\frac{3\frac{1}{2}}{4\frac{1}{2} + 3\frac{1}{2}}\right)$ miles $= 1\frac{5}{7}$ miles;

∴ They will meet $(28\frac{4}{7} - 1\frac{5}{7})$ miles or $\underline{26\frac{1}{7} \text{ miles}}$ from London. Ans.

3. CRACKUS.—A walks to a place at the rate of $4\frac{1}{2}$ miles per hour. At 8 miles from his destination he meets B, and turns back with him (walking at B's rate) for a mile. If A is half an hour late at his destination, what is B's rate of walking, and at what rate should A have walked, after leaving B, so as to arrive at the proper time?

It takes A $\frac{1}{9}$ hour to walk 1 mile at his rate, and 1 mile at B's rate;
A can walk 1 mile in $\frac{2}{9}$ hour.
∴ B " " $(\frac{1}{4} - \frac{2}{9})$ hour $= \frac{1}{36}$ hour;
∴ B's rate per hour $= \frac{36}{1}$ miles $= \underline{36 \text{ miles}}$. Ans.

To walk 8 miles it takes A $\frac{8}{4\frac{1}{2}}$ hours $= 1\frac{7}{9}$ hours;
∴ To arrive at the proper time A must walk 9 miles in $(1\frac{7}{9} - \frac{1}{36})$ hours $= 1\frac{1}{2}$ hours;
∴ He must walk at the rate of $\underline{6 \text{ miles}}$ per hour. Ans.

4. ALONSO.—How many lbs. of tea worth 2s. 6d. per lb. and 3s. per lb., respectively, must be mixed together so that the mixture may be worth 2s. 8d. per lb.?

Gain on first kind $= 2$s. 8d. $-$ 2s. 6d. $= 2$d.
Loss on second kind $= 3$s. $-$ 2s. 8d. $= 4$d.
∴ Quantity at 2s. 6d. : Quantity at 3s. :: 4 : 2
:: 2 : 1. Ans.

5. IVANHOE, Ashby, Z.—In what proportions must tea at 3s. and 3s. 6d. a lb. be mixed, in order to sell at 3s. 8d. a lb. and gain 10 per cent.?

Cost price of mixture $= 3$s. 8d. $\times \frac{100}{110}$
$= 3$s. 4d.
Gain on first kind at this price $= 3$s. 4d. $- 3$s. $= 4$d.
Loss " second " " $= 3$s. 6d. $- 3$s. 4d. $= 2$d.
∴ Quantity at 3s. : Quantity at 3s. 6d. :: 2 : 4
:: 1 : 2. Ans.

6. J. C.—A farmer said if he had as many more horses, $\frac{1}{4}$ as many more, and $\frac{1}{2}$ as many more, he would have 25. How many had he?

He would have $(1 + 1 + \frac{1}{4} + \frac{1}{2})$ or $2\frac{3}{4}$ times as many as at first;
∴ No. he had $= (25 \div 2\frac{3}{4})$ horses
$= \underline{10 \text{ horses}}$. Ans.

7. YELSERP.—A ship 40 miles from the shore springs a leak which admits $3\frac{1}{4}$ tons of water in 12 minutes. 60 tons would suffice to sink her, but the ship's pumps can throw out 12 tons of water in an hour. Find the average rate of sailing so that she may reach the shore just as she begins to sink. (*Barnard Smith.*)

Quantity admitted per hour $= (3\frac{1}{4} \times 5)$ tons
$= 18\frac{3}{4}$ tons;
" left after pumping $= 6\frac{3}{4}$ tons;
∴ Time to sink the vessel $= (60 \div 6\frac{3}{4})$ hours
$= \frac{240}{27}$ hours
$= \frac{80}{9}$ hours;

∴ Average rate of sailing per hour = $(40 \div \frac{8}{9})$ miles
$= \frac{9}{2}$ miles
$= 4\frac{1}{2}$ miles. Ans.

8. EFFIGY.—A passenger train 218 ft. long travelling at the rate of 30 miles per hour overtakes a goods train 453 ft. long travelling at the rate of $22\frac{1}{2}$ miles per hour; how long will the passenger train be in clearing the goods train?

Sum of lengths of trains = (218 + 453) ft. = 671 ft.
Difference of rates " = $(30 - 22\frac{1}{2})$ mls. = $7\frac{1}{2}$ mls.

∴ Time required = $\frac{671 \text{ ft.}}{7\frac{1}{2} \text{ mls.}}$ of an hour

$= \frac{671 \times 2 \times 60}{15 \times 5280}$ min.

$= 1$ min. Ans.

Note.—Find the *sum* of the rates of the trains when going in *opposite* directions, and the *difference* when going in *same* direction.

9. WAMBA.—If a piece of work can be finished in 45 days by 35 men, and if the men drop off by 7 at a time at the end of every 15 days, how long will it be before the work is finished? (*Barnard Smith.*)

Part done by 7 men in 15 days = $\left(\frac{1}{5} \text{ of } \frac{7}{35}\right)$ of the work
$= \frac{1}{25}$ of the work;
Part done in first 15 days = $\frac{1}{45}$ of the work,
∴ Part remaining = $\frac{44}{45}$ of the work;
Part done in second 15 days = $(\frac{1}{25} - \frac{1}{75})$ of the work
$= \frac{1}{75}$ of the work,
∴ Part remaining = $(\frac{44}{45} - \frac{1}{75})$ of the work
$= \frac{43}{45}$ of the work;
Part done in third 15 days = $(\frac{1}{75} - \frac{1}{225})$ of the work
$= \frac{1}{225}$ of the work,
∴ Part remaining = $(\frac{43}{45} - \frac{1}{225})$ of the work
$= \frac{43}{45}$ of the work;
Part done in fourth 15 days = $(\frac{1}{225} - \frac{1}{675})$ of the work
$= \frac{2}{675}$ of the work,
∴ Part remaining = $(\frac{43}{45} - \frac{2}{675})$ of the work
$= \frac{41}{45}$ of the work;
Part done in fifth 15 days = $(\frac{41}{45} - \frac{1}{1125})$ of the work
$= \frac{1}{25}$ of the work.
∴ Time required to complete the work = (15×5) days
$= 75$ days. Ans.

10. SNOWDROP.—If 3 men earn as much as 5 women a day, and 12 men together with 6 women earn £10 8s. in 4 days, what number of women must work along with 10 men that together they may earn £19 13s. 4d. in 10 days?

3 men earn as much as 5 women,
∴ 12 " " " 20 "
12 men & 6 wom. " " 26 "
10 " " " $\frac{5 \times 10}{3}$ " $= 16\frac{2}{3}$ women.

Amount earned in a day in first case = £10 8s. ÷ 4 = £2 12s.
" " " second case = £19 13s. 4d. ÷ 10
= £1 19s. 4d.

£ s. £ s. d. women.
∴ 2 12 : 1 19 4 :: 16 : No. of women in second case.
20 20
52 39
3 3
156 117
6 59
3 $= 19\frac{2}{3}$ women.

∴ No. of women required with 10 men = $(19\frac{2}{3} - 16\frac{2}{3})$ women.
$= 3$ women. Ans.

11. NIP.—What is the least number of years for which simple interest must be reckoned at 4 per cent. on £145 7s. 6d., so that the interest may be an exact number of pounds sterling?

Interest for a year = $\frac{1}{25}$ of £145 7s. 6d.
$= \frac{1}{25}$ of £145$\frac{5}{8}$
$= £5\frac{1}{8}$;
∴ No. of years = 200. Ans.

12. VLADIMIR.—I sell out of the 3 per cents. at 96, and invest in 5 per cent. stock at par; find how much per cent. my income is increased.

Income per cent. in first case = $\left(3 \times \frac{100}{96}\right)$ £
$= £3$ 2s. 6d.
∴ Increase per cent. = £5 − £3 2s. 6d.
= £1 17s. 6d. Ans.

13. JULIUS.—Assuming that the value of 2 Suacan scudi is greater than 10½d. and less than 11d., and the value of an Austrian swanziger is greater than 8d. and less than 8½d., prove that the value of 544 Suacan scudi differs from 355 Austrian swanziger by less than that of 19 Austrian swanziger.
(*Johnson's* 'Civil Service Arithmetic.')

Value of 544 Suacan scudi is greater than (10½d. × 272) or £11 18s., and less than (11d. × 272) or £12 9s. 4d.;
Value of 355 Austrian swanziger is greater than (8d. × 355) or £11 16s. 8d., and less than (8½d. × 355) or £12 11s. 5½d.;
Value of 19 Austrian swanziger is greater than (8d. × 19) or 12s. 8d., and less than 13s. 5½d.
Difference between 544 scudi and 355 swanziger is less than £12 9s. 4d. − £11 16s. 8d., or 12s. 8d.
∴ Difference is less than the value of 19 swanziger.

14. NEPHESH.—The hour and minute hands of my watch are exactly together, and it is between 5 and 6 o'clock. What is the time?

The minute hand moves twelve times as fast as the hour hand;
∴ Difference between the rates of the minute and hour hands is eleven times the rate of the hour hand.
The minute hand must gain twenty-five minutes on the hour hand to be exactly together;
∴ Distance gone by hour hand = 25 min. ÷ 11 = $2\frac{3}{11}$ min.
∴ Time when the hands are together is $27\frac{3}{11}$ mins. past 5.

Note.—Refer to No. 5 of the Arithmetical Queries in our issue for September.

15. G. F. J.—I sold a book to a friend 17 per cent. below cost price; if I had taken his offer of an additional 5s., I should have gained 7 per cent. on my outlay. What did the book cost me, and what did I get for it?

£17 + £7 = £24;
£ s. £
∴ 24 : 5 :: 168 : cost price
6 25
$= 1\frac{2}{3}$s.
= £1 0s. 10d. Ans.

£ £ s. d. £
∴ 168 : 1 0 10 :: 83 : selling price.
2 20 5
20 2 | 415
12 12 | 207½
168 17s. 3½d.
5
= 17s. 3½d. Ans.

16. TRURON.—Arrange $\cdot 7\dot{4}2$, $\sqrt{1\cdot 81}$, and 1·346 in order of magnitude, and find to five places of decimals by how much the sum of the largest and smallest of these numbers differs from twice the other number.

$$\cdot 742\overline{)1\cdot 000}(1\cdot 347708$$
742
2580
2226
3540
2968
5720
5194
5260
5194
6600
5936
664

$$
\begin{array}{r|l}
1\cdot81 & 1\cdot345362 \\
1 & \\
\hline
23 & 81 \\
 & 69 \\
\hline
264 & 1200 \\
 & 1056 \\
\hline
2685 & 14400 \\
 & 13425 \\
\hline
26903 & 97500 \\
 & 80709 \\
\hline
269066 & 1679100 \\
 & 1614396 \\
\hline
2690722 & 6470400 \\
 & 5381444 \\
\hline
 & 1088956
\end{array}
$$

∴ In order of magnitude:—$\frac{1}{1\cdot346}$, 1·346, $\sqrt{1\cdot81}$. Ans.

$$
\begin{aligned}
1\cdot347708 + 1\cdot346 &= 2\cdot693708 \\
1\cdot345362 \times 2 &= 2\cdot690724 \\
&\quad \cdot002984 \\
&= \cdot00298\ldots \text{ Ans.}
\end{aligned}
$$

17. O. H. F.—Three pipes, A, B, and C, in connection with a cistern are opened respectively at 1, 2, and 3 o'clock. A alone can fill it in 3 hours, and B alone in 4 hours, while C can empty it in an hour; at what time will the cistern be empty?

A can fill the cistern in 3 hours,
B " " 4 "
C " empty " 1 hour;
∴ A " fill in 1 hour $\frac{1}{3}$ of the cistern,
B " " $\frac{1}{4}$ "
Part filled when C is opened $= \frac{1}{3} \times 2 + \frac{1}{4}$
$= \frac{2}{3} + \frac{1}{4}$
$= \frac{11}{12}$;

Part emptied in 1 hour when all are open $= 1 - (\frac{1}{3} + \frac{1}{4})$
$= 1 - \frac{7}{12}$
$= \frac{5}{12}$;

∴ Time to empty the cistern $= (\frac{11}{12} \div \frac{5}{12})$ hours
$= \frac{11}{5}$ hours
$= 2\frac{1}{5}$ hours
$= \frac{1}{5}$ hour past 5
$=$ 12 mins. past 5. Ans.

18. OPTO CNAWAN.—A boatman rowing against the tide passes a body floating with the tide, and in 9 minutes afterwards is a mile distant from it; in 35 minutes more he rows $2\frac{1}{2}$ miles, and then returns. At what rate per hour does he return, supposing the tide to flow uniformly in one direction? (*Colenso.*)

He rows $2\frac{1}{2}$ miles in 35 minutes,
" 1 mile " $\frac{35}{2\frac{1}{2}}$ "
$= 14$ "
∴ In 9 min. he rows $\frac{9}{14}$ of a mile,
∴ Rate of tide $= \frac{9}{14}$ of a mile in 9 min.

$$= \left(\frac{5}{14} \times \frac{60}{9}\right) \text{miles per hour}$$

$$= 2\tfrac{6}{21} \text{ miles per hour;}$$

His rate against the tide $= 6\frac{3}{4}$ miles per hour.
$= 4\frac{3}{7}$ "
" without " $= (4\frac{3}{7} + 2\frac{6}{21})$ "
$= 6\frac{3}{7}$ "
∴ " with " $= (6\frac{3}{4} + 2\frac{6}{21})$ "
$=$ $9\frac{9}{21}$ miles per hour. Ans.

Algebra.

1. ROBINSON CRUSOE.—Divide $b(x^3+a^3)+ax(x^2-a^2)+a^3(x+a)$ by $(a+b)(x+a)$.

$$
\begin{aligned}
& b(x^3+a^3)+ax(x^2-a^2)+a^3(x+a) \\
&= bx^3+a^3b+ax^3-a^3x+a^3x+a^4 \\
&= ax^3+bx^3+a^4+a^3b \\
&= x^3(a+b)+a^3(a+b) \\
&= (a+b)(x^3+a^3). \\
& (a+b)(x^3+a^3) \div (a+b)(x+a) \\
&= (x^3+a^3) \div (x+a) \\
&= x^2-ax+a^2. \quad \text{Ans.}
\end{aligned}
$$

2. FOLKESTONIAN.—Divide $(x+1)^6+4(x+1)^5+6(x+1)^4+4(x+1)^3+1$ by x^2+2x+2.

(*Certificate Examination.*)

$$
\begin{aligned}
& (x+1)^6+4(x+1)^5+6(x+1)^4+4(x+1)^3+1 \\
&= \{(x+1)^3+1\}^4 \\
&= \{x^3+2x+1+1\}^4 \\
&= \{x^3+2x+2\}^4 \\
& (x^3+2x+2)^4 \div (x^3+2x+2) \\
&= (x^3+2x+2)^3 \\
&= x^6+6x^5+18x^4+32x^3+36x^2+24x+8. \quad \text{Ans.}
\end{aligned}
$$

3. F. S.—Solve:—

$$\frac{a}{x+a} + \frac{b}{x+b} = \frac{a-c}{x+a-c} + \frac{b+c}{x+b+c}.$$

(Cambridge Local, Junior Algebra Paper, 1879.)

$$
\begin{aligned}
\frac{a}{x+a} + \frac{b}{x+b} &= \frac{a-c}{x+a-c} + \frac{b+c}{x+b+c} \\
\frac{a}{x+a} - \frac{a-c}{x+a-c} &= \frac{b+c}{x+b+c} - \frac{b}{x+b} \\
\frac{ax+a^2-ac-ax+cx-a^2+ac}{(x+a)(x+a-c)} &= \frac{bx+cx+b^2+bc-bx-b^2-bc}{(x+b)(x+b+c)} \\
\frac{cx}{(x+a)(x+a-c)} &= \frac{cx}{(x+b)(x+b+c)} \\
\frac{1}{(x+a)(x+a-c)} &= \frac{1}{(x+b)(x+b+c)} \\
(x+a)(x+a-c) &= (x+b)(x+b+c) \\
(x+a)^2-c(x+a) &= (x+b)^2+c(x+b) \\
x^2+2ax+a^2-cx-ac &= x^2+2bx+b^2+cx+bc \\
2ax-2bx-2cx &= b^2+bc+ac-a^2 \\
2(a-b-c)x &= -(a^2-ac-bc-b^2) \\
2x &= -(a+b) \\
\therefore x &= -\frac{a+b}{2}
\end{aligned}
$$

As we divided both sides of the equation by cx, we obtain a value of x by putting $cx=0$;

$$\therefore x = 0 \text{ or } -\frac{a+b}{2}. \quad \text{Ans.}$$

4. VORTIGERN.—A and B make a joint-stock of £500, by which they gained £160, of which A had for his share £32 more than B. What did each contribute to the stock? (To be solved (1) by the aid of only one letter, and (2) by the aid of two letters.)

(1) Let x = amount contributed by A in pounds,
Then $500-x$ = " " B ";
B received for his share $\frac{1}{2}(£160 - £32) = £64$,
And A " " £64 + £32 = £96;

$$
\begin{aligned}
\therefore \frac{x}{500-x} &= \frac{96}{64} \\
\frac{x}{500-x} &= \frac{3}{2} \\
2x &= 3(500-x) \\
&= 1500-3x \\
2x+3x &= 1500 \\
5x &= 1500 \\
\therefore x &= 300.
\end{aligned}
$$

∴ A contributed £300 and B £200. Ans.

(2) Let x = amount contributed by A in pounds,
And y = " " B " ;

$$\therefore \text{(1) } x+y=500 \quad \text{(2) } \frac{x}{y} = \frac{96}{64}$$

$$
\begin{aligned}
\text{(2) } \frac{x}{y} &= \frac{96}{64} \\
&= \frac{3}{2} \\
2x &= 3y \\
\therefore y &= \frac{2x}{3}
\end{aligned}
$$

$$
\begin{aligned}
\text{(1) } x+y &= 500 \\
x+\frac{2x}{3} &= 500 \\
\frac{5x}{3} &= 500 \\
5x &= 1500
\end{aligned}
$$

∴ $x = 300$, and $y = 200$. Ans.

5. NERO, Pontypridd.—x^4+rx+s has a divisor of the form $(x+a)^3$, if $\left(\frac{s}{3}\right)^3=\left(\frac{r}{4}\right)^4$. Prove this.

$$x^2+2ax+a^2)x^4+\ rx\ +s(x^2\ -2ax+3a^2$$
$$x^4+2ax^3+a^2x^2$$
$$-2ax^3-a^2x^2+rx+s$$
$$-2ax^3-4a^2x^2-2a^3x$$
$$3a^2x^2+(2a^3+r)x+s$$
$$3a^2x^2+6a^3x+3a^4$$

$\therefore x^4+rx+s$ has a divisor of the form $(x+a)^3$, if $2a^3+r=6a^3$, and $3=3a^4$.

$$2a^3+r=6a^3 \qquad\qquad s=3a^4$$
$$\therefore r=4a^3 \qquad\qquad \frac{s}{3}=a^4$$
$$\frac{r}{4}=a^3 \qquad\qquad \left(\frac{s}{3}\right)^3=a^{12}$$
$$\left(\frac{r}{4}\right)^4=a^{12}$$

$\therefore$ It is divisible if $\left(\frac{s}{3}\right)^3=\left(\frac{r}{4}\right)^4$. Ans.

6. AUGUSTINE.—Divide 46 into two parts, such that if one part be divided by 7, and the other part by 3, the sum of the quotients shall be 10. (*Todhunter.*)

Let x = one part,
then $46-x$ = other part

$$\therefore \frac{x}{7}+\frac{46-x}{3}=10$$
$$3x+322-7x=210$$
$$3x-7x=210-322$$
$$-4x=-112$$
$$\therefore x=28.$$

$\therefore$ Parts are 28 and 18. Ans.

7. READER.—In a race of ten miles between a horseman and a man on foot, the man on foot has 5 minutes start. A part of the race was by the side of a railway where the man on foot meets a train going in the opposite direction. He passed it in $3\frac{1}{17}$ seconds. In exactly one minute afterwards the horseman passed the train in 3 seconds. The man on foot won the race by $27\frac{5}{11}$ seconds. Supposing the train to be $76\frac{4}{11}$ yards long, at what rate of speed per hour did the man on foot, the horseman, and the train run, respectively, and where did the man on foot, and the horseman meet the train?

Rates of train and horseman in miles per hour—

$$=76\tfrac{4}{11}\times 20\times 60\div 1760$$
$$=\frac{\overset{52}{\cancel{840}}\times\cancel{60}}{\cancel{1760}\ \cancel{22}}$$
$$=52;$$

Rates of train and man on foot in miles per hour—

$$=76\tfrac{4}{11}\times 60\times 60\div(3\tfrac{1}{17}\times 1760)$$
$$=\frac{\overset{\cancel{22}}{\cancel{840}}\times\cancel{3600}\times 17}{\cancel{22}\times\cancel{1760}\ \cancel{60}}$$
$$=51.$$

Gain by horseman in 10 miles—

$$=5\text{ min.}-27\tfrac{5}{11}\text{ secs.}$$
$$=(5-\tfrac{5}{11})\text{ min.}$$
$$=4\tfrac{6}{11}\text{ min.}$$
$$=\tfrac{5}{12}\text{ hr.}$$

Let x = rate of man on foot in miles per hour,
Then $x+1=$,, horseman ,, ,, ;

$$\therefore \frac{10}{x}-\frac{10}{x+1}=\frac{5}{60}$$
$$\frac{2}{x}-\frac{2}{x+1}=\frac{1}{60}$$
$$2x+2-2x=\tfrac{1}{60}(x^2+x)$$
$$x^2+x=120$$
$$x^2+x+(\tfrac{1}{2})^2=120+\tfrac{1}{4}$$
$$=\tfrac{481}{4}$$
$$x+\tfrac{1}{2}=\tfrac{21}{2}$$
$$\therefore x=11.$$

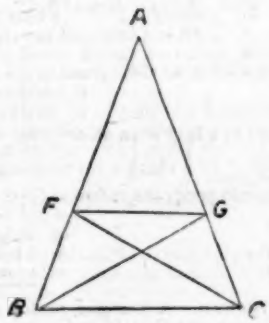
$\therefore$ Rate of man on foot per hour = 11 miles,
,, horseman ,, = 12 ,,
,, train ,, = (51 − 11) miles
= 40 miles.

In one minute train goes $\frac{40}{60}$ or $\frac{2}{3}$ of a mile,
,, ,, horseman ,, $\frac{44}{60}$ or $\frac{11}{15}$,,
$\therefore$ When man on foot meets train, horseman is $(\frac{2}{3}+\frac{1}{5})$ or $\frac{13}{15}$ of a mile behind him;
$\therefore$ Horseman has gained $(\frac{11}{12}\times 5-\frac{13}{15})$ of a mile
$=(\frac{11}{12}-\frac{13}{15})$ of a mile
$=\frac{7}{60}$ of a mile;
Horseman gains 1 mile in an hour,
$\therefore$,, ,, $\frac{1}{60}$,, 3 min.;
$\therefore$ Distance gone by man on foot when he meets train
$=\{\frac{11}{12}\times(3+5)\}$ miles
$=\frac{88}{12}$ miles
$=1\frac{7}{12}$ miles. Ans.

$\therefore$ Distance gone by horseman when he meets train
$=(\frac{11}{12}\times 4)$ of a mile
$=\frac{11}{3}$ of a mile. Ans.

Geometry.

1. GARFIELD.—Prove the fifth proposition (Book I.) without producing the sides.



Take F in AB, and make AG = AF. Join FC, GB, FG.

Proof.—The two sides FA, AC = the two sides GA, AB, each to each,
and the angle FAG is common to the two triangles AFC AGB;
$\therefore$ the base FC = the base GB,
and the angle ACF = the angle ABG. (I. 4.)

In the triangles FBG, GCF, the two sides FB, BG = the two sides GC, CF, each to each,
and the angle FBG = the angle GCF,
$\therefore$ the two triangles are equal; (I. 4.)
the angle BFG = the angle CGF,
and the angle FGB = the angle GFC;
$\therefore$ the angle BFC = the angle CGB. (Ax. 3.)

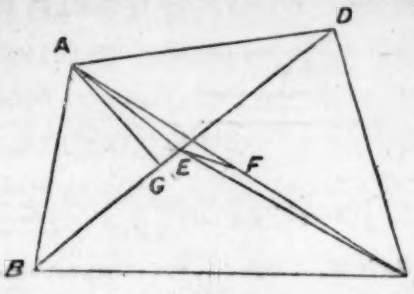
In the triangles BFC, CGB, the two sides BF, FC = the two sides CG, GB, each to each,
and the angle BFC = the angle CGB,
$\therefore$ the two triangles are equal, and the angle FBC = the angle GCB. (I. 4.) Q. E. D.

Note.—(1) None issued that we know of. (2) Mansford's, 1s. 6d. (Hughes); Wollman's, 1s. (Jarrold's). (3) Writing pretty fair.

DANEBURGH.—The squares on the sides of a quadrilateral are together greater than the squares on its diagonals by four times the square on the straight line joining the middle points of its diagonals.—(*Todhunter*).

Let the diagonals BD, AC of the parallelogram ABCD be bisected in E, F.

Draw AG perpendicular to BD, and join AE, CE, EF.



Proof.—$AB^2 = BE^2 + AE^2 - 2BE.EG$, (II. 13.)
$AD^2 = DE^2 + AE^2 + 2DE.EG$; (II. 12.)
$\therefore AB^2 + AD^2 = 2BE^2 + 2AE^2$; (Ax. 2.)

Similarly, $BC^2 + CD^2 = 2BE^2 + 2CE^2$;

$\therefore$ Squares on the sides of the quadrilateral $= 4BE^2 + 2AE^2 + 2CE^2$.

Again, $AE^2 + CE^2 = 2AF^2 + 2EF^2$, and the doubles of these are equal;

$\therefore$ Squares on the sides of the quadrilateral $= 4BE^2 + 4AF^2 + 4EF^2 = BD^2 + AC^2 + 4EF^2$.

$\therefore$ Squares on the sides are together greater than the squares on the diagonals by four times the square on EF. Q. E. D.

Mensuration.

1. NORMAN.—A conical wine-glass 2 inches broad and $2\frac{1}{2}$ inches deep is half filled with water. Find the depth and quantity of water.

$$\text{Content of glass} = \frac{1^2 \times 3{\cdot}14159 \times 2\frac{1}{2}}{3} \text{ cub. in.}$$
$$= \frac{3{\cdot}14159 \times 5}{6} \text{ cub. in.}$$
$$\therefore \text{ Quantity of water in glass} = \frac{15{\cdot}70795}{12} \text{ cub. in.}$$
$$= \underline{1{\cdot}30809\ldots\text{cub. in.}} \quad \text{Ans.}$$

Let $\underline{H}$ be the depth of the glass, $\underline{h}$ the depth of the water, $\underline{a}$ the area of top of glass, and $\underline{b}$ the area of surface of water. Then,

$$a : b :: H^2 : h^2.$$
$$\text{Content of glass} = \tfrac{1}{3}aH,$$
$$\text{water} = \tfrac{1}{3}bh.$$
$$\therefore \tfrac{1}{3}bh = \tfrac{1}{3}aH$$
$$2bh = aH$$
$$\therefore b = \underline{\frac{aH}{2h}}.$$
$$\therefore a : \frac{aH}{2h} :: H^2 : h^2$$
$$2h : H :: H^2 : h^2$$
$$\therefore 2h^3 = H^3$$
$$= (\tfrac{5}{2} \text{ in.})^3$$
$$= \tfrac{125}{8} \text{ cub. in.}$$
$$h^3 = \tfrac{125}{16} \text{ cub. in.}$$
$$\therefore h = \sqrt[3]{7{\cdot}8125} \text{ cub. in.}$$
$$= \underline{1{\cdot}98425\ldots\text{in.}}$$
$$\therefore \text{ Depth of water in glass} = \underline{1{\cdot}98425\ldots\text{in.}} \quad \text{Ans.}$$

General.

1. E. JONES.—The book you require is *Johnston's* 'English Composition and Essay Writing,' price 3s. 6d. (Longmans).

2. C. OLLYS.—*Murray's* 'Grammar,' 3s. 6d. (Allman: by *Ellis*, 1s. (Dean): 2d., cloth 4d. (Hardwicke): by *E. D. Jackson*, 6d. (Heywood): 32mo. 6d., 12mo. 3s., closer lines, 2s., (Mozley): 'Exercises,' 2s., closer lines 1s., Key, 2s., (Mozley): 'Grammar,' 3s., (Tegg). There are also several abridgments.

3. ORKNEY.—The Agent-general for New South Wales is The Hon. Saul Samuel, C.M.G., 5, Westminster Chambers, S.W.

4. INCOGNITO.—To give a full account of the Egyptian Debt would occupy much more space than we can spare and would not be of much interest to our readers. We must refer you, therefore, to any of the standard works on Egypt. 'The Encyclopædia Britannica' devotes some pages to the subject.

5. ENQUIRER.—We do not know the book you mention. There is one called *Beeton's* 'Public Speaker,' published by Ward, Lock and Co., price 3s. 6d.

6. SILVIUS.—*Barnard Smith's* 'Arithmetic' 4s. 6d. (Macmillan). *Mansford's*, 1s. 6d. (Hughes). *Hamblin Smith's* 3s. 6d. (Rivingtons).

7. M. WELLS.—The preposition *to* is not an essential part of the infinitive mood, nor an invariable sign of it. Many verbs (as *may, can, shall, will, must, let, dare, do, bid, make, see, hear, feel, need*) are followed by the simple infinitive without *to* (*Mason's* 'Grammar,' paragraph 195).

8. J. KIRKE.—Iceland is supposed to have been inhabited by a small colony of Irish Culdees long prior to its historic discovery about the year 860, and for about sixty years after that date, a tide of immigration set in towards it from Norway, the Western Isles (Hebrides), and from Ireland.

9. FRED.—The interval from F sharp to the C next above is an *Imperfect fifth*, comprising two tones and two semitones. This interval is also called the Diminished 5th, the False 5th, and the Flat 5th. The Perfect 5th would be from F upwards to C (both natural), or from C to G. Making the G sharp, the interval would become an Augmented 5th: this latter is a Chromatic interval; the two former 5ths are Diatonic.

10. MIDLOTHIAN SUBSCRIBER.—Your answer is correct.

11. A READER.—You will find the solution of your deduction in our issue for May.

12. PESTACHIO.—On looking at a globe or map it will be noticed that all the great and continuous tracts of land become pointed as they stretch towards the south, by which they are made to assume a pyramidal or triangular form at the extremity. The continents of North and South America and of Africa are the most remarkable illustrations of this fact.

In reference to the continents of Europe and Asia, there is also the general tendency to taper towards the south; in the former continent, however, this tendency is greatly obstructed by the vicinity of the African continent, so that Spain and Portugal do not so manifestly assume the triangular form. Still this tendency is partially developed in various parts of the south of this continent; as in the conformation of Italy and Greece, which taper, but very irregularly, towards the south, evidently in consequence of the feebler action of the Mediterannean Sea, as compared with the full play of the great Atlantic and Pacific Oceans. In the latter continent, the tendency to taper towards the south has been divided in such a manner as to present the three peninsulas of Arabia, India, and Malacca.

The small peninsula of Jutland is an exception to the general rule, as it points northward.

13. BARDD COCOS.—*Todhunter's* 'Algebra for Colleges and Schools,' 7s. 6d.

14. DELTA.—Your solution is incorrect, as you have taken the walk *outside* the garden, instead of taking it part of the garden. How could the walk take up half the ground, if it was outside the garden?

15. B. W. R.—It should be proved that AD falls nearer to AB than AE, but there is a much simpler solution than the one you have forwarded. In your method of proof by drawing AG perpendicular to BC, you assume that G falls between B and D.

16. PRECEPTOR.—The time at which Arabic numerals were introduced into Europe is not definitely known, but it is supposed that the knowledge of them was brought to Spain early in the 11th century by the Arabs, and from thence transmitted throughout the rest of the Continent. Their introduction into England was very gradual, for in the writings and inscriptions of

the Middle Ages they are constantly found mixed up with Roman numerals (thus xxx2 for 32, x4 for 14), and it was not until the commencement of the 16th century that their use became really general.

17. KRODON.—*Addison's* 'Papers on the Imagination,' 3d. (W. and R. Chambers). We do not know of any annotated edition of *Swift's* 'Battle of the Books.' His whole works can be obtained in the Bohn Series, and also, we believe, from Messrs. Chatto and Windus.

18. WAMBA.—A thorough knowledge of Parts I. and II. will be sufficient, but, of course, if you have time it would not be labour lost to try the more advanced sections of Part IV.

19. ENTRE-NOUS.—In the sentence 'He is as strong as you, although he looks like death,' *as* is an adverb qualifying *strong*; *strong*, an adjective qual. *He: as*, a conjunction connecting 'He is as strong' to 'you (are strong);' *although*, a subordinative conjunctive, connecting 'he looks like death' to the preceding sentence; *like*, adj. qual. *he; death* is governed by the prep. 'to' understood.

In the sentence 'Tom also says so,' *also* is an adverb qualifying *says*. *So* is a pronoun, object. case governed by *says*, and equivalent to *the same thing*. Many people would, however, class this last word as an adverb.

20. MAESTRO.—The expression 'She looks nice' is quite correct, and, unlike many colloquialisms, can be defended on grammatical grounds. The verb *looks* is one of incomplete predication, and as it is intransitive, the complement of the predicate stands in the predicative relation to the subject; that is, to apply the case to the sentence in question, the word *nice* is predicated or asserted of the subject *she*, and not of the verb *looks*, and consequently the adjective *nice* is used, and not the adverb *nicely*. (See *Mason's* 'Gram.,' paragraph 393.)

21. AP MERLIN.—Get *Johnston's* 'Guide to the Civil Service,' price 3s. 6d. (Longmans). Candidates, of course, do not take in *all* the subjects specified in your list, but only the obligatory ones and such of the voluntary as they deem themselves proficient in. It is of no use, whatever, 'taking up' subjects of which you have but a smattering. The marks obtained for a subject do not count at all unless they rise above a certain per centage of full marks. We shall be happy to advise you on the books required, when you have selected your subjects. The papers in *Cassell's* 'Popular Educator' are excellent.

22. ARABI.—The easiest and quickest way is by the Protractor, as equal arcs subtend equal angles at the centre.

23. PWLLHELI.—From St. John ix.

A (*a*) And His disciples asked Him, saying,

(Principal Sentence.)

And	Connective
His disciples	Subject
asked	Predicate
him	Object (indirect)
saying	Enlargement of subject

(*b*) Which is by interpretation, Sent.

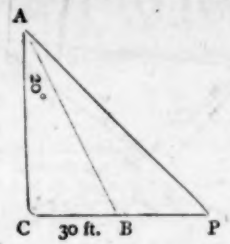
(Adjective Sentence.)

Which	Subject
is Sent	Predicate
by interpretation	(=being interpreted) Attribute of subject.

BRITISH MUSEUM 31 OC 82

B (*a*) That he was born blind. (Adverbial Sentence.)
(*b*) Go, wash in the pool of Siloam. (Noun Sentences.)
(*c*) A man made clay. (Noun Sentence.)
(*d*) Go to the pool of Siloam. (Noun Sentence.)

24. COOPE.—ABC is a triangle with a right angle at C, CB a 30 ft. long and BAC is 20°. If CB is produced to a point P, such that PAC is 55°, calculate the length of CP. (*Science and Art*, 1882.)



Angle BAC=20°, ∴ angle ABC=70° (I. 32), and angle PAB =35°;

But angle ABC=angles APB, PAB, (I. 32.)

∴ angle APB=35°,

and therefore BP=BA (I. 6).

In the triangle ABC,

AB : BC :: Sin ABC : Sin BAC

AB : 30 :: Sin 90° : Sin 20°

AB : 30 :: 1 : ·3420201

∴ AB=30÷·3420201

=87·714...

∴ CP=CB+BP

=(30+87·714...) ft.

=117·714...ft. Ans.

Note.—Stage 3. *Todhunter's* 'Algebra for Colleges and Schools'; *Potts'* 'Euclid'; *Todhunter's* 'Plane Trigonometry,' or 'Spherical Trigonometry.' *Stage* 4. *Drew's* 'Conic Sections'; *Todhunter's* 'Conic Sections.'

25. SHEEPY.—Although we have spent a considerable time over your equation, we cannot obtain a solution, and therefore must believe the mathematical tutor at the college must have given it incorrectly.

26. MANACLES.—(1) Get your secretary to write to the Department for the form. (2) *Cornwell's* 'Geography.' (3) No.

27. NOTNAPS.—'She is not *so* good a scholar *as* he is.'

So—Adv. of man. mod. the adj. 'good.'
As—Conj., Copulative, joining the sentences 'she is not so good a scholar,' and 'he is a good scholar.'

28. W. R.—(1) The surface will be level. (2) The pressures depend on the area of the surface and the depth. (3) The pressure is proportional to the depth. (4) If a sliding-scale were attached to the gauge, the variations in pressure could be noticed.

29. CARRIE.—Send for copy of terms to the Secretary, Wesleyan Training College, Horseferry Road, Westminster, S.W. The terms vary from time to time.

30. AUGUSTINE.—No: must be advanced section.

31. PETO.—It is desirable, but not necessary, to do so. The fee will be paid.

PERPLEXED.—(1) No. (2) The candidate must apply himself, having obtained permission from the Department to sit before October 1st. Fee nominal. (3) No. (4) Produced at the examination.

——o——

We are pleased to announce that Mr. Wrightson has been appointed lecturer at South Kensington in the new Department of Agricultural Chemistry, and that the practical instruction will be in charge of Mr. Chapman-Jones.

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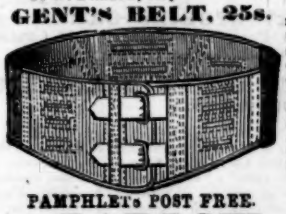

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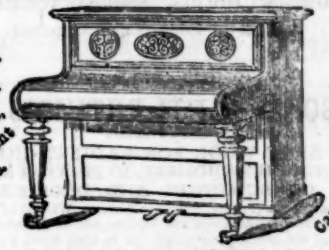

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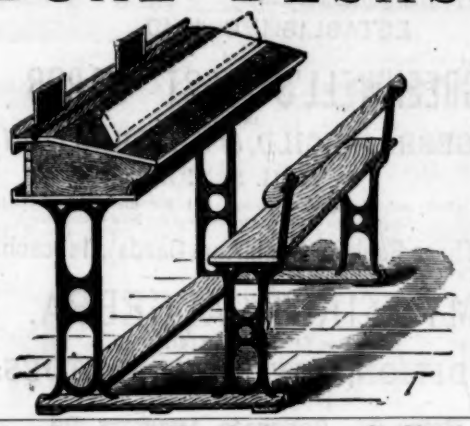

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